

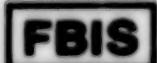
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2 July 1980

# China Report

SCIENCE AND TECHNOLOGY

No. 43



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2 July 1980

CHINA REPORT  
SCIENCE AND TECHNOLOGY  
No. 43

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PHYSICAL SCIENCES

DISCOVERY OF HARKERITE REPORTED

Beijing DIZHI PINGLUN [GEOLOGICAL REVIEW] in Chinese Vol 25 No 2, 2 Dec 79  
pp 80-84

[Article by Wang Shufeng [3769 2579 7685]: "The Discovery of Harkerite in Our Country"]

[Text] The magnesium skarns of Guangdong's Dading Tin and Iron Mine contains a rare type of boron-bearing mineral known as harkerite. This kind of mineral was first discovered by C. E. Tilley in 1948 in the magnesium skarns of Scotland's Skye Island<sup>(1)</sup>. Since the 1960's, it has been found in the same type of mineral deposits in Siberia's Yakut and Alaska's Seward Peninsula<sup>(2,3)</sup>.

The Dading Tin and Iron Mine is situated in the contact zone between the Shihai rocks [4258 5154 1484 7555] and Triassic Upper Series dolomite layer where magnesium skarns are very well developed. The major minerals in magnesium skarns are: boltonite, magnesium spinel and fassaite. The chief kinds of magnesium skarns are: magnesium spinel-boltonite skarns, magnesium spinel-augite-boltonite skarns, magnesium spinel-augite skarns. On the outskirts of the magnesium skarns, there are also boltonite-calciphyre and periclasite-calciphyre rocks. The magnesium skarns and calciphyre rocks subsequently underwent flouborite metasomatism, calcium skarnization, greisenization, etc.

The chief external manifestations of the flouborite metasomatism of magnesium skarns were: the magnesium spinel rocks were replaced by phlogopite; in certain sections, the boltonite rocks were transformed into humite group minerals, and replaced by kotoite or magnesium-ludwigite metasomatism in other areas. Correspondingly, the background of magnesium skarns underwent transformations and thus formed into such rocks as phlogopite pyroxenolite, magnesium spinel-bearing augite humite, phlogopite augite humite, etc.

The prominent features of calcium skarnization are: the fassaite rocks underwent partial elimination of  $Al_2O_3$ , and developed into diopsite-common augite, subdiopsite-common augite, asteroite; magnesium spinel rocks were mainly replaced by cuparcite or intermediate garnet constituents in the process of metasomatism; boltonite was transformed into magnesium-monticellite; magnesium-ludwigite was changed into ferroludwigite; kotoite

was replaced by harkerite, etc. Correspondingly, near the boundary of the two adjacent rocks or on both sides of the fissures, the following rocks were formed: augite skarn, augite-duparcite skarn, augite-garnet skarn, monticellite skarn, ferroludwigite skarn, harkerite skarn, etc.

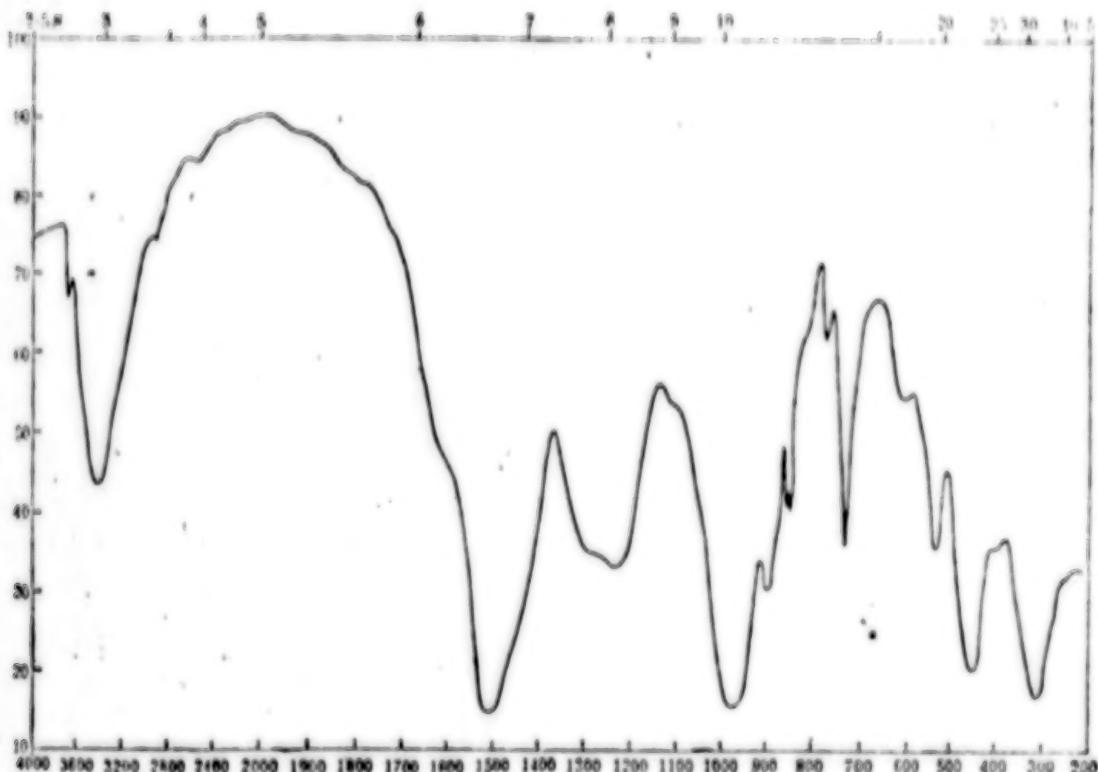


Figure 1. Infrared absorption spectrum of harkerite

Lab conditions: scanning time = 8 minutes; gain = 4; slot N; sample slide KBr. Measurements were made by Guo Lihe [6753 4539 7729], Sixth Division, Mineral Deposit Geology Research Institute, Chinese Academy of Geological Science

Harkerite is a special kind of mineral produced by magnesium skarns and their flouborite altered rocks in the process of calcium skarnization. The samples show granular aggregates, milk white color, oily luster, high degree of hardness; in appearance, it looks very much like quartz, but drops of dilute hydrochloric acid can cause acute effervescence, which differentiates it from quartz. Observation with lens reveal the granular features of the harkerite which is also characterized by projections in the center, colorless with a vitreous lustre, and no signs of polychroism or cleavage on its fractured surface (Photo 1) [not reproduced]. It has isotropic effects with zonal structure, and manifests abnormal extinction.

Table 1. Chemical constituents of harkerite

(1) 项 分	(2) 重量(%)	(3) 分 子 数	(4) 阳离子的原子数	(5) 阴离子的原子数	(6) 假晶胞中的原子数	(7) 电荷数
SiO <sub>4</sub>	12.19	0.2029	0.2029	0.4058	11.62	46.48
CO <sub>3</sub>	13.52	0.3073	0.3072	0.6144	17.58	70.32
BeO <sub>4</sub>	9.00	0.1292	0.2584	0.3876	14.80	44.40
Al <sub>2</sub> O <sub>3</sub>	2.47	0.0242	0.0484	0.0726	2.77	8.31
Fe <sub>2</sub> O <sub>3</sub>	1.09	0.0068	0.0136	0.0204	0.78	2.34
FeO	0.33	0.0046	0.0046	0.0046	0.26	0.52
MnO	0.15	0.0021	0.0021	0.0021	0.12	0.24
MgO	11.57	0.2870	0.2870	0.2870	15.43	32.86
CaO	46.67	0.8322	0.8322	0.8322	47.64	95.28
			1.2504		112.00	301.76
H <sub>2</sub> O <sup>+</sup>	2.17	0.1204	0.2408	0.1204	13.78	153 148.75(OH)
Cl	1.56	0.0400		0.0400	2.29	4.26(OH)
F	0.36	0.0189		0.0189	1.08	
(9) 总 和	101.06					
Cl <sub>2</sub> =O	0.36					
F <sub>2</sub> =O	0.15					
(10) 校正后的总和	100.55					

(11) 分析者: 中国地质科学院原地质矿产研究所八室刘玉芬

(12) 结晶化学式:  $(\text{Ca}_{0.44}\text{Mg}_{0.56})_{12}(\text{Mg}_{1.00}\text{Fe}_{0.23}\text{Mn}_{0.11})_{12-13}(\text{Al}_{1.19}\text{Fe}_{0.77})_{2-3}(\text{Be}_{1.40}\text{Al}_{0.20})_{12}\text{Cl}_{17.58}(\text{Si}_{11.62}\text{Al}_{0.77})_{12}\text{O}_{147}\text{Cl}_{2.34}$   
 $(\text{O}_{1.25}\text{F}_{0.12}\text{OH}_{3.78})_2 \cdot 3\text{H}_2\text{O}$ (13) 注1. 其理论式为:  $\text{Ca}_{12}\text{Mg}_{12}\text{Al}_3(\text{BO}_3)_{12}(\text{CO}_3)_{12}(\text{SiO}_4)_{12}\text{Cl}_2(\text{OH})_2 \cdot 3\text{H}_2\text{O}^{(+)}$   
2. 与理论值的偏离, 主要在于样品未到足够纯度

Key:

1. Components
2. Weight (%)
3. Molecular ratio
4. Cationic atomic number
5. Anionic atomic number
6. Atomic number in pseudo-cell
7. Electric charge
8. Oxygen
9. Sum
10. Total after correction
11. Analyst: Liu Yufen [0491 3768 5358], 8th Division, Research Institute of Autochthonous Geological Mineral Products Chinese Academy of Geological Science
12. Crystal chemical formula:  
 $(\text{Ca}_{0.44}\text{Mg}_{0.56})_{12}(\text{Mg}_{1.00}\text{Fe}_{0.23}\text{Mn}_{0.11})_{12-13}(\text{Al}_{1.19}\text{Fe}_{0.77})_{2-3}(\text{Be}_{1.40}\text{Al}_{0.20})_{12}\text{Cl}_{17.58}(\text{Si}_{11.62}\text{Al}_{0.77})_{12}\text{O}_{147}\text{Cl}_{2.34}$   
 $(\text{O}_{1.25}\text{F}_{0.12}\text{OH}_{3.78})_2 \cdot 3\text{H}_2\text{O}$
13. Note: 1. Theoretical formula:  $\text{Ca}_{12}\text{Mg}_{12}\text{Al}_3(\text{BO}_3)_{12}(\text{CO}_3)_{12}(\text{SiO}_4)_{12}\text{Cl}_2(\text{OH})_2 \cdot 3\text{H}_2\text{O}^{(+)}$   
2. The deviation of the theoretical values is mainly due to the lack of purity of the samples.

Through measurements, it is determined that its specific gravity is 2.93 (torsion balance method) hardness 5.5 ( $H_v = 545$  g per sq micrometer); refractive index  $N_p = 1.6560 \pm 0.0002$  (simple variation method); infrared absorption spectrum, as shown in Figure 1; chemical composition as shown in Table 1; and Table 2 compares the chemical compositions between harkerites found in China and foreign countries.

Table 2. Comparison of chemical compositions between harkerites found in China and foreign countries

产地 (1) 分	(2)	1 苏格兰斯 凯岛 <sup>(2)</sup>	2 苏格兰斯 凯岛 <sup>(2)</sup>	3 西伯利亚 雅库特 <sup>(3)</sup>	4 西伯利亚 雅库特 <sup>(3)</sup>	5 广东大庾	6 理论成分
SiO <sub>2</sub>	12.74	14.17	9.35	8.50	12.19	12.68	
TiO <sub>2</sub>	—	—	—	0.11	—	—	
CO <sub>2</sub>	13.90	14.94	14.46	15.71	13.52	13.92	
B <sub>2</sub> O <sub>3</sub>	9.20	7.77	11.17	11.50	9.00	9.18	
Al <sub>2</sub> O <sub>3</sub>	2.51	2.84	2.59	3.20	2.47	2.69	
Fe <sub>2</sub> O <sub>3</sub>	0.87	0.85	0.13	1.00	1.09	—	
FeO		0.46	0.77	0.84	0.33	—	
MnO	—	0.02	0.08	0.12	0.15	—	
MgO	11.32	11.15	11.05	9.90	11.57	11.30	
CaO	46.31	46.25	46.92	45.10	46.67	47.32	
Na <sub>2</sub> O	—	—	0.17	0.20	—	—	
K <sub>2</sub> O	—	—	0.07	0.06	—	—	
H <sub>2</sub> O <sup>+</sup>	—	0.11	0.15	0.45	—	—	
H <sub>2</sub> O <sup>-</sup>	1.92	0.81	1.01	21.4	2.17	1.90	
Cl	1.26	1.36	2.12	2.12	1.56	1.25	
F	—	—	—	—	0.36	—	
(3) 不溶物	—	—	0.72	—	—	—	
(4) 总和	100.13	100.71	100.95	100.95	101.06	100.28	
Cl <sub>2</sub> =0	0.27	0.31	0.48	0.48	0.36	0.28	
F=0	—	—	—	—	0.15	—	
(5) 校正后的总和	99.86	100.40	100.47	100.47	100.55	100.00	
N	1.653	1.653	1.652	1.660	1.6560	—	
(6) 比重	2.94	2.96	2.93	—	2.93	2.94	
$a_0 \text{ \AA}$	29.53	29.53	29.46	—	29.51	—	

(7) 注: 1. 与之组合的矿物为透辉石、方解石、磁铁矿、闪锌矿、黄铜矿; 2. 与之组合的矿物同1; 3. 与之组合的矿物为钙镁橄榄石、镁尖晶石; 4. 与之组合的矿物是透辉石、方解石。

Key:

1. Components
2. Place of origin:
  1. Skye Island, Scotland (Reference 4)
  2. Skye Island, Scotland (" 1)

[Key continued on following page]

3. Yakut, Siberia (Reference 4)  
 4. Yakut, Siberia (" 4)  
 5. Dading, Guangdong  
 6. Theoretical composition  
 3. Insoluble substances  
 4. Sum  
 5. Total after correction  
 6. Specific gravity  
 7. Footnote: 1. associated with the following minerals: diopsite, calcareous spar, magnetite, garnet blende, chalcopyrite; 2. associated with the same minerals as those in 1; 3. associated with the following minerals: monticellite, magnesium spinel; 4. associated with the following minerals: diopsite, calcareous spar

Table 3 shows the x-ray powder data for harkerite. Based on the high angular diffracted ray  $d = 1.065\text{\AA}$  index of 16.16.16, its  $a_0$  axis parameter coincides with Tilley's  $a_0 = 29.53\text{\AA}$ .

Harkerite is extremely similar to sakait (caxant, sakait) in external appearance, optical character and genetic geological environment. The major properties of the two minerals are shown in Table 4.

Table 3. X-ray powder data for harkerite\*

<i>d</i>	<i>i</i>	<i>hkl</i>	<i>d</i>	<i>i</i>	<i>hkl</i>
5.19	3	440	1.74	4	16.4.4; 12.12.0
4.74	2		1.70	5	10.10.10; 18.10.2
3.85	1	533; 731	1.65	4	16.8.0
3.38	1	662	1.56	2	12.12.8
3.017	4	844	1.50	9	16.8.8
3.00	3	755; 771; 933	1.31	9	16.16.0
2.83	4	666; 10.2.2	1.285	2	18.14.2; 18.10.10
2.60	10	880	1.269	2	20.12.0; 16.12.12
2.34	3	12.4.0	1.250	3	20.12.4
2.125	9	888	1.230	2	24.0.0
2.07	3	14.2.2; 10.10.2	1.166	8	24.8.0
2.04	3		1.115	6	24.8.8
1.97	5	12.8.4	1.086	7	24.12.4
1.92	2	10.10.6; 14.6.2	1.065	7	16.16.16
1.84	9	16.0.0	0.987	9	
1.79	2				

Photography conditions: Fe target, 35 kilovolts; 6 mA, exposure 15 hours  
 Analyst: Zhang Jianhong [1728 1696 3163], X-ray Lab, Wuhan Geological College

\*Diffraction index based on Ostrovskaya's data (Reference 4)

Table 4. Comparison between the main properties of harkerite and sakalite (Ref 2)

Chief physical and chemical properties	harkerite $\text{Ca}_2\text{Mg}_{1-x}\text{Al}(\text{BO}_3)_3(\text{CO}_3)_x(\text{SiO}_4)_3\text{Cl}_x(\text{OH})_y \cdot 3\text{H}_2\text{O}$	sakalite $\text{Ca}_2\text{Mg}_{1-x}\text{Al}(\text{BO}_3)_3(\text{CO}_3)_x\text{Cl}_x(\text{OH})_y \cdot 4\text{H}_2\text{O}$
Crystal form	Octahedra crystal form, compact matrix aggregate	
Color	White to light gray, colorless and transparent	
Luster	Glossy luster to oily luster	
Hardness	5	
Specific gravity		
Lab measurement	2.93-2.96	2.78-2.84
Computed	2.94	2.79
Refractive index	1.650-1.660; isotropic, sometimes with abnormal extinction (fan abnormal extinction)	1.638-1.646; isotropic
Crystallization system	Isometric; $a_0 = 29.53\text{\AA}$	isometric; $a_0 = 14.64^\circ$
Thermal properties	Begins to disintegrate at 850 degrees	Begins to disintegrate at 700 degrees
Acidic erosion	Dissolves in strong hydrochloric acid with acute effervescence and even dissolves in weak acids	

Dading's harkerite is found between magnesium spinel-bearing augit-humite and brucite-griotte. This means that it depends on three kinds of formation media: boltonite-calciphyre, magnesium spinel-bolitonite skarn, and magnesium spinel-augite-boltonite skarn. In the first kind of medium, harkerite often occurs in the form of monomineralic accumulations; in the latter two kinds of rocks, it is combined with many kinds of minerals, primarily as follows:

harkerite + clino-augite\*\*+duparcite + flouborite;  
harkerite + clino-augite + garnet\*\*\*+ flouborite + humite group;  
harkerite + clino-augite + humite group + flouborite;  
harkerite + clino-augite + flouborite:  
harkerite + clino-augite + humite group + garnet + cuspidite;  
harkerite + clino-augite + garnet + monticellite + humite group;  
harkerite + garnet + monticellite;  
harkerite + garnet:  
harkerite + humite group.

Based on observations of petrometallogenic phenomena, it is conjectured that the characteristic reaction of the ~~formation~~ of Dading's harkerite could be as follows:

calcareous spar + kotoite + magnesium spinel + boltonite → harkerite + periclase

There could be other characteristic reactions as well.

The harkerite here was replaced primarily by magnetite ores in the course of endogenic geological process (Photo 2) [not reproduced]; in hypergenic environment, it often underwent acute carbonation.

My special thanks to the comrades of the 938 Team's Rock Mineral Group of the Guangdong Metallurgical-Geological Exploration Company who helped to identify harkerite and classify the samples.

Footnotes:

\*\*Footnote 1: Analysis of 10 monomineralic samples reveal that this type of augite is the isomorphous mixture of  $\text{CaMgSi}_3\text{O}_8$ ,  $\text{CaFeSi}_3\text{O}_8$ ,  $\text{CaMnSi}_3\text{O}_8$ ,  $\text{NaFeSi}_3\text{O}_8$ ,  $\text{Mn}_3\text{Si}_3\text{O}_8$ ,  $\text{CaAlAlSi}_3\text{O}_8$ ,  $(\text{Ca}, \text{Na})\text{FeAlSi}_3\text{O}_8$ . The variation range of augite molecules is 92-15 percent, the variation range of asteroite molecules is 2-78 percent.

\*\*\*Footnote 2: Analysis of 3 monomineralic samples reveal that it is the isomorphous mixture of  $\text{Ca}_3\text{Fe}_2\text{Si}_3\text{O}_12$ ,  $\text{Ca}_3\text{Al}_2\text{Si}_3\text{O}_12$ ,  $\text{Fe}_3\text{Al}_2\text{Si}_3\text{O}_12$ ,  $\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_12$  and  $\text{Mn}_3\text{Al}_2\text{Si}_3\text{O}_12$ , the first two being predominant. The variation range of andradite molecules is 84-39 percent, and the variation range of essonite molecules is 9-15 percent.

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## APPLIED SCIENCES

### PLANT PIONEERS IN INTEGRATED CIRCUITS FOR ELECTRONIC WATCHES

Shanghai JELFANG RIBAO in Chinese 23 Apr 80 p 2

[Article: "Vying to Shoulder a Heavy Load for the Four Modernizations"]

[Text] The main component of a fourth-generation electronic wristwatch, an integrated circuit with advanced 1970's characteristics, is in successful experimental production at the Shanghai Watch Parts Plant, filling a gap for this country's electronic watch industry.

When the Shanghai Watch Parts Factory is mentioned, the name is not unfamiliar to people, since back in the 1960's it proposed the stirring slogan "What other countries have, we must and will have!" Stimulated by this slogan, they practiced self-reliance, worked hard for the country's prosperity, and successfully developed this country's first hairsprings and jigs. This newspaper used the slogan as a headline to introduce their stirring feats. Today, as we advance toward the four modernizations, it still shows the impressive aspect of those days, and has shouldered a heavy burden for the country.

The integrated circuits of fourth-generation electronic wristwatches have a high level of integration, small size, low power consumption and contain more than 2,000 tubes on a surface the size of a bean. Their current consumption must be less than 3 microamperes, a stiffer requirement than that imposed on ordinary computer integrated circuits, and a more difficult one. Originally the relevant departments did not include the Shanghai Watch Parts Factory among the key organizations in the work of developing such circuits. But the factory came out in front; many comrades there, including plant manager Qiu Jindao [0092 6651 6670], had a strong sense of responsibility and a feeling of urgency about developing this country's electronic wristwatches. In 1974, when electronic wristwatches appeared abroad, they proposed to make electronic wristwatches and electronic wristwatch parts, and made this the future development orientation of the factory. Accordingly he organized several people to start development work on third-generation electronic wristwatches. After learning from others, they began their own development work.

8480  
CSO: 4008

## APPLIED SCIENCES

### IMPROVEMENT IN TWELVE-INCH PICTURE TUBES DESCRIBED

Shanghai JIEFANG RIBAO in Chinese 30 Apr 80 p 2

[Article: "Quality of Shanghai-Produced Twelve-Inch Picture Tubes Improved"]

[Text] Shanghai-produced twelve-inch television picture tubes have been on the market in this city for a month, and consumer response has been excellent. Recently further improvements have been made, and the quality has overtaken that of imported models.

Some 1,100 of the Shanghai-produced twelve-inch picture tubes were put on the market in Shanghai in April. After they went on the market, the Shanghai Communications and Electronics Procurement and Supply Station and technical cadres of the relevant industrial departments went to the counters, interviewed consumers, and convened a conference of managers of the relevant retail stores, seeking opinion in various quarters. The consumer response was uniformly excellent; they said "The Shanghai-produced twelve-inch picture tubes were developed quickly and have stable qualities." Everyone offered opinions on shortcomings, namely that the phosphor screen of the tubes was rather more yellow than those of imported models. The industrial departments took this opinion seriously, particularly the No 4 Electronic Tube Factory, which produces Haishi [3189 3740] brand twelve-inch picture tubes, and took effective steps, deepening the glass color and making adjustments in the process for painting the phosphor powder on the screen, so that now the problem of excessive yellowness has been solved.

Recently the Shanghai No 4 Electronic Tube Factory produced a lot of picture tubes with these improvements incorporated and installed them in more than 3,000 television sets of seven different models, which have already been dispatched to Beijing by the communications and electronics station for sale at about the time of the May Day festival, and is again soliciting consumer opinion and improving the quality of the Shanghai-produced picture tubes so as to put them into large-scale production for installation in television sets for the market.

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## APPLIED SCIENCES

### UNDERWATER CABLE LINK WITH JAPAN IMPROVED

Shanghai JIEFANG RIBAO in Chinese 2 May 80 p 1

[Article: "Assistant Technician Zhao Le Improves Imported Equipment"]

[Text] Young assistant technician Zhao Le [6392 2867] of the China-Japan undersea cable land station, Shanghai Municipal Radio Administration Office, has for many years delved painstakingly into the technology of his job, and he boldly improves imported equipment, making an outstanding contribution to assuring free movement of traffic on the cable.

This cable is an international sea-bottom communications cable between China and Japan and a bond of friendship between the Chinese and Japanese peoples. The cable was formally opened in October 1976. At that time, the technician responsible for the cable was 20-year-old Zhao Le. The cable is an advanced communications installation of the 1970's, but because the equipment is in some respects unsuited to the changes in voltage level of our power sources, sometimes communications quality is affected. On one occasion, the Lingbei [1545 0554] land station in Japan discovered that one signal received from Shanghai was not normal. When Zhao Le found out about this, he observed the signal for the entire night, and found no malfunction in the equipment. However, the abnormality would not disappear. Without resting, he continued to search for the cause, and after many simulation tests, he finally found the root of the problem. He immediately reported it to the Japanese side, and when the Japanese side corrected it, the signal again became normal.

In his day-to-day work of safeguarding communications, Zhao Le discovered that this imported equipment still has certain technical problems, such as that the telephone ringing equipment had considerable feedthrough of the ringing signal to the electrical circuits, and because the imported equipment was not suited to this country's voltage variation circumstances, there were frequent "micsues" in telephone communications, which was somewhat detrimental to operation. These two technical problems were rather difficult ones to solve, but difficulty did not frighten Comrade Zhao Le, and after more than a year's extensive testing and collection of data, and more than several dozen experiments, he finally found the best approach

to correcting the problems. Over the last few years, without fear of difficulty, he has made five technical improvements on advanced imported equipment and has made a certain contribution to improving undersea cable communication quality.

Comrade Zhao Le is now only 24 years old. After he started work at the land station, he painstakingly studied English and Japanese, and rapidly mastered both written languages. Every Sunday he goes to the Shanghai library and borrows large numbers of foreign technical books on undersea communications, so that he has rather thoroughly mastered undersea communications technology. Because he has made noteworthy improvements during his undersea cable communications work, he recently was designated a model worker for Shanghai City.

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CSO: 4008

## APPLIED SCIENCE

### NATIONAL SEMICONDUCTOR PHYSICAL-CHEMICAL ANALYSIS CENTER SUCCESSES DETAILED

Beijing GUANGMING RIBAO in Chinese 6 May 80 p 2

[Article: "National Semiconductor Physical-Chemical Analysis Center Takes Preliminary Form"]

[Text] As a result of a joint effort by the relevant departments, the National Semiconductor Physical-Chemical Analysis Center, scheduled to be constructed in Beijing, has taken preliminary form after 3 years' work, has organized a core team to do analytical research and is beginning to serve national semiconductor production and research.

The task of the physical-chemical analysis center is to use all kinds of advanced physical and chemical analytical equipment to carry out analytical research on basic semiconductor materials, component technologies, process reagents, and particularly some microscopic phenomena of materials surfaces, thin layers and microregions, and continuously to improve process technology and development standards. The establishment of the analysis center will provide a powerful impetus to this country's development of semiconductor technology.

This country's semiconductor technology, and particularly our development of large-scale integrated circuits, currently faces the primary problems of low end-product rate, unstable quality, resultant high expenses and high operating costs, and accordingly extreme wastage of manpower and materials. One main reason for this is the lack of research on base materials, impurities in the component fabrication process, defects and failure mechanisms. To solve this problem, with the approval of the State Computer Committee, it was decided to set up the National Semiconductor Physical-Chemical Analysis Center within the Institute of Semiconductors, Chinese Academy of Sciences. Domestically produced equipment is used wherever possible on 18 research topics requiring large-scale precision instruments; of 36 planned import items, two-thirds have already been received and most of these have been accepted and installed for use. Last year, the institute used this equipment to do research on certain topics; it published 10 articles in national technical periodicals and had exchanges of opinion on 21 papers at national technical conferences, as

well as contributing to the development of a 4,096-bit NMOS large-scale integrated circuit, overcoming initial unfamiliarity, and has increased the end-product rate to over 20 percent. On the principles of concentrating on general applicability of equipment and instruments and an orientation toward nationwide use, they have tested more than 4,900 specimen chips, including more than 900 routine analyses done for organizations outside the institute. In addition, the institute has also completed the compilation of a book more than 400,000 characters long entitled "Testing and Analysis in Semiconductor Science and Technology," has held a conference on "Physical-Chemical Analysis" for the Peking municipal physical-chemical cooperative network, and have cooperated in the training of personnel.

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CSO: 4008

## APPLIED SCIENCES

### RESONANCE IN AFTERGLOW PLASMAS, APPLICATIONS IN SPACE RESEARCH

Beijing DIQIUWILI XUEBAO [ACTA GEOPHYSICA SINICA] in Chinese Vol 23 No 1, Jan 80 pp 13-18

[Article by Ziao Zuo [5135 0146] of the Geophysics Department of Beijing University: "Resonance in Afterglow Plasmas and Its Possible Applications in Space Research"]

#### [Text] Abstract

This article was received on 7 May, 1979

By using resonance probe to conduct measurements in afterglow plasmas, the resonance effect can be observed. The conclusion that differs from those of some writers is that it can be proven that this resonance occurs within the plasma at frequency  $\omega_p$  without strong damping. If it can be shown that this method of measurement can be used to measure the concentration of plasmas without bringing about any polluting effect by the probe, then this technique may have possible applications in the study of space plasmas.

#### I. Introduction

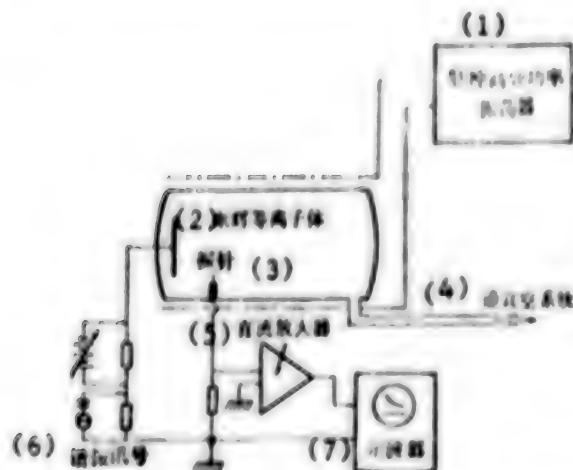
At the beginning of the 1960's, K. Takayama et al developed the resonance probe on the basis of the Langmuir probe. The principle was later applied in the direct measurement of electron density in the ionosphere.<sup>1,2</sup> Since then, many conducted experimental and theoretical work and discussed the mechanism of resonance. R.S. Harp et al pointed out in a summary critique: ordinarily resonance occurs far below the plasma frequency of  $\omega_p$ . Under some conditions resonance is present near  $\omega_p$  but strong damping is encountered and thus it is very difficult to observe it in experiments. Therefore they have expressed doubt concerning the use of this principle to probe the ionosphere.<sup>3</sup>

But the simplified models used in various theoretical analysis cannot strictly correspond with experimental conditions, and the effect of conducting experiments in a continuously discharging plasma upon the ion source is not clear. This article describes the experiment of conducting resonance probes in afterglow plasmas. It was discovered that resonance still occurred at the plasma frequency under afterglow conditions and it was also shown that this kind of technique may have possible applications in plasma studies of interest to some fields of space physics.

## II. Equipment of the Experimental and Principle

The experimental equipment was similar to the type of equipment used by D. Smith et al<sup>4</sup> in studying afterglow plasmas. The principle is illustrated in Figure 1. The duration was 10 microseconds. A repeated frequency of a pulse of 50 cycles/second modulated a 10MC high frequency oscillation to excite a discharge chamber to produce the plasma. Pure helium was used in the experiment. In the lapse time between two pulses and thus between two discharges, the density of the plasma attenuated according to a definite pattern. The way of attenuation was determined by the mechanism that caused loss in the plasma.

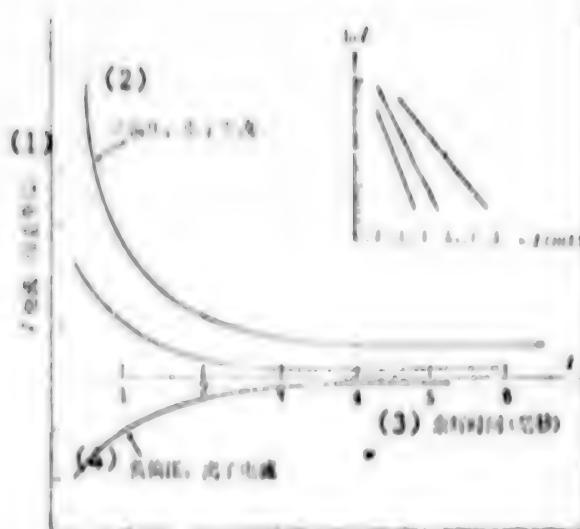
The resonance probe was an ordinary cylindrical Langmuir probe. Direct current bias voltage was placed near the floating electric potential but slightly towards the negative, and an appropriately high frequency oscillation was superimposed to observe resonance. The relationship of the change in the current of the typical Langmuir probe with the duration of the afterglow when the high frequency oscillating signal was not superimposed is illustrated in Figure 2. The change in current represented the attenuation of density with time. Different bias voltage corresponds to different forms of curves. At a definite afterglow time, continuous change in the direct current bias voltage can trade the characteristic curve of the ordinary Langmuir probe. Corresponding surveying techniques are listed in reference 5.



### Key:

- (1) Pulsed high frequency power oscillator
- (2) Afterglow plasma
- (3) Probe
- (4) To vacuum system
- (5) Direct current amplifier
- (6) Resonance signal
- (7) Oscilloscope

Figure 1. Illustration of experimental equipment



**Key:**

- (1) I current (any unit)
- (2) Positive bias voltage, electron current
- (3) Afterglow time (milliseconds)
- (4) Negative bias voltage ion current

Figure 2. Relationship between afterglow line and current gathered by the Langmuir probe (at upper right corner is the half logarithmic coordinates)

Figure 3 [not reproduced] shows the situation of an actual measurement. The bottommost curve represents the change in time of the current of the ordinary Langmuir probe. Because it is located at a position where the floating potential is slightly towards the negative, the probe gathers cation current. The position of the bright spot marks the 2.8 millisecond of the afterglow. The center trace line shows a high frequency signal of a frequency of 288 MC and an amplitude of about  $1V_{pp}$  causing resonance at 2.8 millisecond in the plasma. This is manifested as a sudden change in the current of the probe at the corresponding time on the curve of attenuating current. By changing the frequency of the high frequency signal, one can record the sudden changes in current at different times. The following analysis shows this resonance occurs at the plasma frequency.

### III. Results of Experiment and Analysis

A set of resonance experiments were conducted under different air pressures between 0.13 - 1.26 tonometric units in pure helium. Under each fixed pressure, a group of resonance frequency data corresponding to different afterglow times was obtained. Let the resonance occur at a plasma fre-

quency of  $f_p = \left(\frac{N_e}{e}\right)^{\frac{1}{2}}$ , then the curve of time variation of the densities of the afterglow plasma can be calculated by conversion. Based on the results of experiment, a shower of such curves is computed by conversion. They appear in the half logarithmic diagram in Figure 4 as a shower of good straight lines. This shows the converted attenuation of density following the time indices:

$$n_t = n_0 e^{-\lambda_a t} \quad (1)$$

Here, the defined attenuation  $\lambda_a$ , is the slope of each curve in Figure 4.

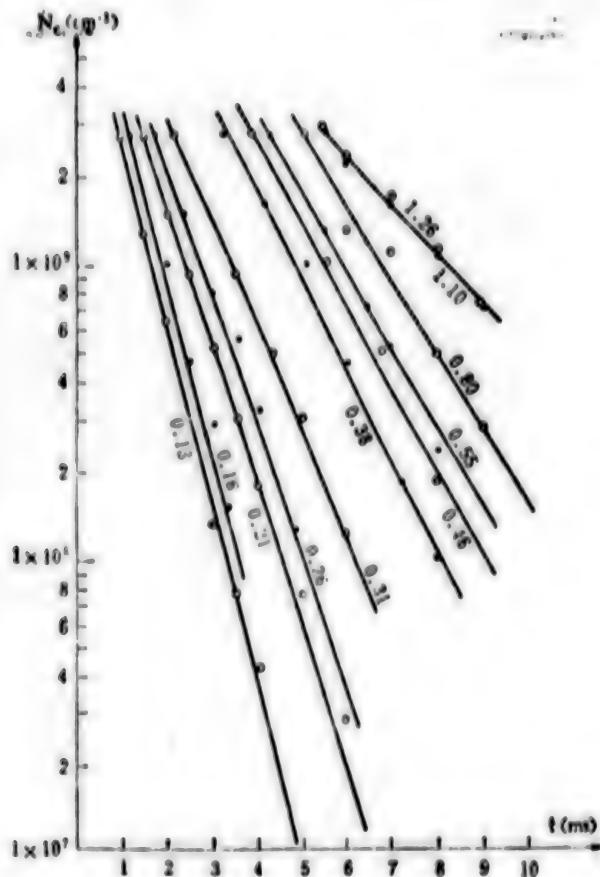


Figure 4. Relationship between converted plasma densities and duration of afterglow (half logarithmic coordinates)

The straight lines from left to right separately correspond to air pressure (units of tonometer): 0.13; 0.16; 0.21; 0.26; 0.31; (the two lines at the extreme right coincide)

Figure 5 shows the converted radial distribution of density by letting the probe move in the radial direction, measuring radial distribution of the resonance frequency of the time of one afterglow from the center to the wall of the instrument under the same conditions, and letting the resonance frequency correspond to  $f_p$ .

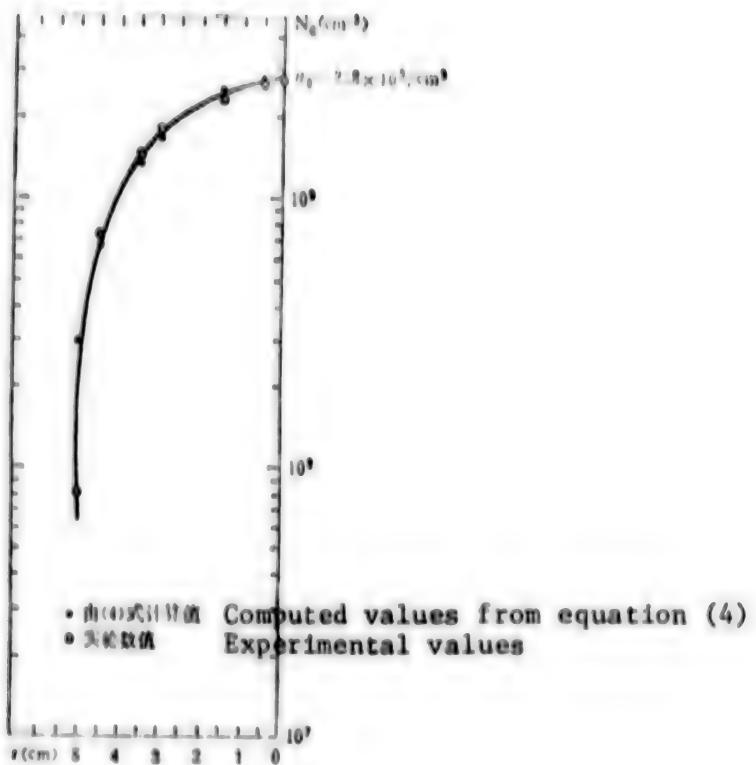


Figure 5. Radial distribution of plasma density obtained by conversion  
 $P = 0.63$  tonometric units  $t = 3.3$  ms

The most important results of the two groups of experiments above are as follows: Although the resonance at  $f_p$  is only a hypothesis, the temporal and spatial distribution of density derived, like what will be described in the following, coincides with theoretical analysis and also coincides with experimental results obtained by others. This indicates that the above hypothesis is reasonable. The following is a further discussion of this.

According to H. J. Oskam,<sup>6</sup> under conditions corresponding to this experiment, the major process of loss of charged particles is the doppler dispersion of the basic mode and the three-state conversion of the atomic ions into molecular ions in the presence of neutral molecules. At this time, the relationship of time change of the density of electrons during the afterglow period can be expressed by the following:

$$n_e = n_{10} \left( 1 - \frac{v}{\lambda_1 - \lambda_2} \right) \exp(-\lambda_1 t) + \left( n_{20} + \frac{vn_{10}}{\lambda_1 - \lambda_2} \right) \exp(-\lambda_2 t) \quad (2)$$

In the above equation,  $n_{10}$  and  $n_{20}$  respectively represent the densities of the  $\text{He}^+$  and  $\text{He}_2^+$  ions,  $\alpha$  is the speed of conversion of  $\text{He}^+$  to  $\text{He}_2^+$  ions,  $\lambda_1$  and  $\lambda_2$  are constants of attenuation of densities of each of the two kinds of ions and they are respectively related to the coefficients of dipolar dispersion of the two ions and the characteristic measures of dispersion of the basic mode and the discharge container. When  $\lambda_1 \approx \lambda_2$ , we have

$$n_e = (n_{10} + n_{20}) \exp(-\lambda t) \quad (3)$$

Under the air pressures in our experiment, the situation generally corresponds to this relationship. Under other air pressures, attenuation of density may separately approach  $\lambda_1$  or  $\lambda_2$ , both are index attenuation. This conclusion is consistent with the experimental results we obtained in equation (1).

Oskam also pointed out if the attenuation caused by dipolar dispersion of the basic mode is the major process, then the radial distribution of the plasma density in the cylindrical container can be expressed by the zero order Bessel function:

$$n_r = n_0 J_0 \left[ 2.41 \frac{r}{R} \right] \quad (4)$$

In equation (4),  $R$  is the radius of the cylinder of the container. In this experiment,  $R = 5.5$  cm,  $n_r$  and  $n_0$  are respectively the distance  $r$  from the axial line and the electron density on the axial line. Taking  $n_0$  as the experimental value, we obtained the theoretical values computed by equation (4) and shown as black round dots in Figure 5. They coincide with the experimental results.

The theories behind equations (2), (3) and (4) have earlier been proven by experiment<sup>4,7</sup> using such different methods as mass spectrometer and the Langmuir probe by D. Smith et al. Now we have obtained the same results using the resonance method.

Harp pointed out in his summary critique<sup>3</sup>: Most resonance which can be observed occur far below the plasma frequency:

$$\omega_p = \frac{\omega_p}{[1 + (R/\lambda_D)]^{\frac{1}{2}}} \quad (5)$$

In equation (5),  $R$  is the radius of the ball-shaped probe,  $\lambda_D$  is the debye length of the plasma,  $k = 5$ , and only when the size of the probe compared to  $\lambda_D$  is far smaller than 5 will the resonance occur approximately at  $\omega_p$ , but he believes under this condition the resonance cannot be observed because of strong damping.

In our experiment, we used a cylindrical probe of a diameter of  $15\mu$ . The afterglow period  $\lambda_D$  varies with time between 100 and 400  $\mu$ . The ratio  $R/\lambda_D$  never surpassed 0.2, but the resonance that occurred at  $\omega_p$  was clear and easily observed and strong damping was not observed.

#### IV. Conclusions and Discussion

If resonance occurs at any other frequency than  $\omega_p$ , then the consistency of this experimental result with the theories of (3) and (4) cannot be explained. Thus:

1. Under conditions of our experiment, resonance was observed at  $\omega_p$  and there was no strong damping. This technique can in principle be applied to the experiment of several afterglow plasmas, such as the study of certain coefficients of recombination or conversion after ionization of gases. When conditions are appropriate, the resonance principle can also be used in direct measurements of the ionosphere.

2. The advantage of this kind of technique is that it is not affected by the material of the probe or the changes in the work function caused by surface pollution. In measurements using the Langmuir probe, the surface of the probe must frequently be cleaned first by electron bombardment to avoid causing errors in measurement due to surface pollution. For example, when using the Langmuir probe to directly measure the parameters of the ionosphere, pollution caused distortion<sup>8</sup> in the results of measurements of the intensity of the electric field and electron temperatures. Figure 6 [not reproduced] shows this effect. The left and right characteristic curves correspond to the same plasma conditions, but the curve on the right was obtained after the probe was cleaned while the curve on the left was obtained one to two minutes afterwards. Obviously, the effect of pollution has caused the characteristic curves not to coincide. This kind of effect is called lagging of the characteristic curve. In pictures shown in Figure 3, the upper curve and the middle curve are respectively the resonance measurements obtained by a clean probe and one that was not cleaned. They both correspond to the same condition. It can be seen that resonance occurs at the same position and is unaffected by pollution.

The preliminary conclusion above indicates this kind of technique may possibly have actual significance in the measurement of plasmas in space and in the laboratory. Of course, the effects of the size of the probe, the bias voltage, the intensity of the high frequency signal and such factors must be subjected to more experimentation. But it is important that resonance at  $\omega_p$  was observed. Whether there is damping or not at least this should be studied further under afterglow conditions. Recently, K.C. Li et al developed the method of a scanning probe to measure plasma density and proved that resonance occurred at  $\omega_p$  under a negative bias voltage. He proposed two kinds of mechanisms which can also be considered under conditions of our experiment.<sup>9</sup>

Finally, it must be pointed out, a kind of resonance that is linearly related to  $\omega_p$  in plasmas actually exist--parametric resonance. This type of resonance may possibly satisfy equations (3) and (4). Some people have conducted experiments<sup>10</sup> in the excitation of parametric resonance. In recent years, excitation of parametric instability in plasmas in the ionosphere and in the laboratory is an important topic. Several Langmuir probe measurements taken simultaneously with this experiment did not show that the resonance was systematically higher than whole multiples of  $\omega_p$ . However, the possibility of conducting excitation of parametric resonance in the laboratory is worth our attention.

Thanks is hereby given to the following: Most of the experimental data in this article was obtained using related equipment of the Department of Space Research at Birmingham University. Thanks is given to the Head of the Department Professor A.P. Willmore and Dr D. Smith who was in charge of the laboratory. Thanks is also given to Comrade Lu Baowei [0712 0202 4850] of the Electronics Institute of the Chinese Academy of Sciences and Comrade Yuan Dingpu [5913 1353 2613] of the Physics Institute who have provided beneficial suggestions.

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APPLIED SCIENCE

TECHNICAL CONSULTATION IN SHANGHAI IMPROVES QUALITY

OW071657 Beijing XINHUA in English 1500 GMT 7 Jun 80

[Text] Shanghai, 7 Jun (XINHUA)--Various technological associations in Shanghai, the biggest industrial city in China, are giving "technical consultation" to help factories solve problems arising in their technical innovation.

Taking part in the service are noted specialists, engineers and technicians. They receive visitors by turns in their spare time. Generally, the service is available once a week for three or four hours with two or three specialists on duty.

The consultation is free of charge. Technicians, apart from giving guidance, design blueprints to process spare parts for factories if required.

This new technical service is welcomed by manufacturers, particularly by medium-sized and small factories with a relatively weak technical force.

For instance, the Xinya Radio Components Factory, because of a certain technical problem, had failed to revamp its three-kilowatt oven with the infrared ray technique. The factory's technicians asked the infrared ray "technical consulting" office in Xuhui District for help. The office sent technicians to the factory to help revamp the oven. After one month of hard work, the oven's consumption of electricity was reduced to 0.9 kilowatts.

The Shanghai technological associations also offer technical services to factories outside Shanghai that seek technical assistance.

For example, a factory in Guangdong Province needed to plate its hinges with copper, but the problem could not be solved in the province. Its technicians travelled thousands of miles to Shanghai for help. A plating "consultation" office in Xuhui District designed the copper-plating process for the factory and asked a local factory to train copper-plating workers for Guangdong.

CSO: 4020

## APPLIED SCIENCES

### AIRCRAFT POWER PLANTS TEST BEDS DESIGNED, BUILT

Beijing GUANGMING RIBAO in Chinese 13 Apr 80 p 2

[Article by Hang Yan (2635 1484) of the Third Ministry of Machine Building: "The Broad Path Toward Regeneration Through Our Own Strength--the Revelation of the New Test Beds For Aircraft Engines Designed and Built by Our Country"]

[Text] Recently, our country successfully designed test beds for aircraft engines. They have been officially put into use. Both in the aspects of directing ideas and working methods, they presented some useful experiences.

#### It Is by Relying On the Chinese People That We Ourselves Will Fulfill the Four Modernizations Program

The technical conditions of test beds for aircraft engines are highly demanding. The metering and testing accuracy of the principal items is one grade higher than that of the current test beds available in the country. In 1975, when some foreign experts and some of our comrades began pondering this problem, they worried that we might not be able to solve it in a short period of time. They suggested that we introduce a whole new set of equipment from abroad. To introduce the equipment or to construct them was a big decision. In this regard, the Third Ministry of Machine-Building Industry had organized its subordinate unit, the Fourth Institute of Planning and Design, and the related plants to study and analyze the problem diligently. All of us believed that the cost of introducing new equipment was too high and that the lead time for goods delivery was too long. The introduction would not satisfy us in time to meet the demand of testing programs for our engines. If we were to manufacture them domestically, we might need high technology for which we lacked complete information. We had only a short time to act. There were many difficulties as well as a definite "risk." However, we realized that we must not underestimate ourselves by neglecting our strength and our favorable conditions.

For the last 20 or more years, our country has designed and built various engine test beds and some piston-type turbo-jets and turbine shafts.

Accumulating more design experiences and having some better technical foundations could pave the way to creating some conditions for doing it ourselves. Also, it was pointed out that in order to fulfill the goals of China's four modernizations program, we must, in the final analysis, thoroughly rely on the Chinese people to do it, especially since our country is large and lacks experience. Whatever things we can design and manufacture by our own efforts we should not purchase from abroad. If there were some "risk" in doing it ourselves, would the introduction of equipment from abroad have no "risk" at all? Through repeated research, we have strengthened our confidence and decided to design and manufacture the equipment by ourselves.

#### A Strict Scientific Attitude, As Well As Being Bold in Blazing New Trails, Is Required

With respect to the advanced techniques at home and abroad, we had the alternative of total copying or of creating and improving the existing foundation with diligence and digestion. That was another important question encountered in the course of constructing the test beds. In order to learn and grasp the advanced techniques of test beds, the design personnel had examined the gains and losses, successes and failures in designing 100 or more test beds built since the founding of this nation. Also, they had read a large volume of books and publications, which referred to the foreign techniques of the advanced test beds. They finally determined to adopt the superior features and to create venturously new ideas in the light of the actual conditions in our country. In the main structure, we adopted more than 10 domestic and foreign advanced design techniques. In the past, our test bed installation shops had been using a single frame base for installing the test beds. In order to prevent vibration from spreading, it was necessary to adopt the measures for reducing and insulating the vibration, which is labor-consuming, costly, and less efficient. This time, in reference to the advanced techniques from abroad and in accordance with the principle of self-vibration frequency, they venturously built an integrated structure that combines a frame base with a plant base. They attained good results by using fewer materials, by speeding up the project and by achieving a high degree of strength. As to the test beds, they employed the suspension type of base frame. These were simple structures with good rigidity, high measuring accuracy, broad visibility, and convenient operation and maintenance. Because the indoor testing resulted in a high noise level, the key to this important technique was noise reduction. In order to obtain better results in noise reduction, instead of resting on the current technical level, they searched for new ways through numerous tests. A total of seven noise reduction measures have been adopted for the test beds. The new techniques enabled the air intake and exhaust noise levels to be reduced to 10 plus decibels lower than those of original test beds in the country. They also vastly improved the working conditions for the testing personnel. In the exhaust muffling section, they employed the exhaust passage made up of variable frequency open-hole diffusers and baffles, and "resistance" mufflers. This was the very first utilization of this type of device in this nation. Previously, our country's design

personnel, with strict scientific attitude, conducted numerous tests by utilizing the thermal shock technique and calibrated wind tunnels and single tubes and other testing equipment. They obtained more than 10,000 pieces of data. Having confidence in the dependability of the data, they then decided to employ them. Trial runs proved that the design was a complete success. The foreign technical personnel believed that the exhaust muffler "induced the air flow extremely well under either the thrust-augmented or non-augmented conditions, and the noise-reducing effects were very good." Regarding the entire test bed project, the comments made by the experts in the country were that the project is new in structure and compact in arrangement, and reflects our country's unique characteristics.

The test beds, from design, manufacture and installation to adjustment and testing, have been constantly kept in line with strict scientific approaches by us to insure high quality. For example, after the installation of the test beds, the foreign technical experts, working together with our technical personnel and workers, conducted strict inspections and trial runs of the test beds. They examined every single system, checked every instrument, and calibrated every parameter. They conducted trial runs under 75 different conditions. Four thousand five-hundred pieces of data were recorded. One hundred twenty-nine performance characteristic curves were drawn. Thirty-four hours of approved and calibrated trial runs had been successfully conducted. One hundred and fifty hours of prolonged tests had also been successfully carried out. The results proved that the design, manufacture, and installation of the test beds completely met the requirements for the ground testing of the new-type engines.

#### Develop the Spirit of Socialist Cooperation

Cooperation can produce high-level results. Cooperation can promote new productive forces. In the process of constructing the test beds, the entire project has been greatly supported by 100 and more units throughout the country. They helped solve the many equipment, facility and technical problems, thereby considerably accelerating the process of construction. For example, a special kind of noise-eliminating bricks were required to build the test beds. The Xi'an City Construction Materials Plant spent more than 3 months in studying over 20 formulas. Eventually, they succeeded in building the new type of noise eliminating bricks. That satisfied the requirement. The test beds required new instruments. For that reason, the instrument and meter plants concerned cooperated in speeding up production. Sichuan Instrument and Meter Plant No 1 successfully trial manufactured a platinum resistor atmosphere (Tl) temperature meter. The system accuracy reaches 0.1 °C. Foreign experts praised it as "king of Tl temperature measurement." Because of great cooperative efforts from all the units, they not only assured the pace of the construction, but also the quality of putting the project together. This practice proved that some matters and some of the technical problems might appear to be very hard to solve in an area, a department, or a plant. These problems could be solved readily if the related scientific research organizations, institutions of higher learning and production enterprises in the country

cooperate with one another. The fact that our country has successfully designed and built a new type of test bed for aircraft engines enables us to recognize profoundly that in order to carry out the four modernizations program with speedy, better, and more economical results, we must correctly handle the relation between the introduction of foreign advanced techniques and the development of our country's new techniques through self-reliance. If it is necessary and possible, we certainly must introduce some foreign advanced technology and equipment. However, we must not underestimate ourselves. We must see that we have formed a fairly large contingent of technical personnel through 30 years of construction. We have built up a good material foundation, and accumulated many experiences in both positive and negative aspects. These are dependable position for carrying out the four modernizations and starting point for going forward continuously. What we need to import are only those advanced techniques and key equipment that we have not yet mastered and are urgently needed.

We must not introduce from abroad the scientific and technical results already achieved through research in the country and the equipment and products that have either been produced or which we are capable of manufacturing through efforts. Introduction of technology and equipment must be advantageous to us and must not be against the popularization and application of our scientific and technical results in the country. It must not cause some of our production capacities to be idle or products to be unmarketable. Introducing suitable foreign advanced technologies under the prerequisites of protecting and promoting our own fruitful scientific researches and developing our own new technologies, with stress on self reliance is the one and only correct policy.

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REGRESSION ANALYSIS OF DUCTED PROPELLER CAVITATION DATA PRESENTED

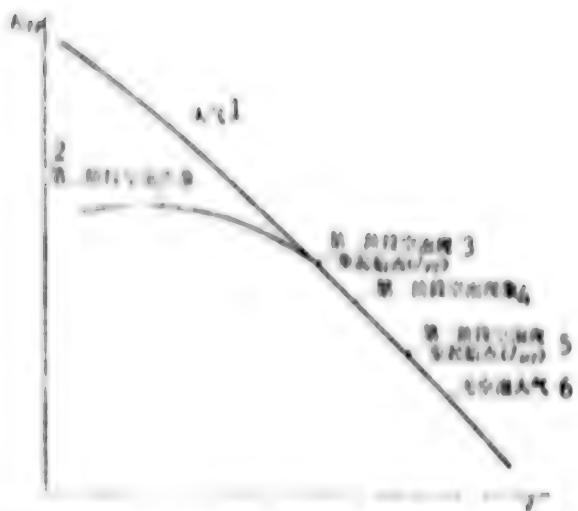
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[Article by Zhou Liandi [0719 6647 4574], Ye Yuanpei [0673 0337 1014] and Zheng Yongmin [6774 3057 2404]: "Use of Regression Analysis in Treating Experimental Data from Cavitation Tunnel Tests of Ducted Propeller Series"]

(Text) ABSTRACT: This article discusses the question of how to use regression analysis to treat data from cavitation tunnel experiments on series of ducted propellers. The key to the method is finding the actual position of onset of second-stage cavitation and the question of how to treat the problem of the junction of the characteristic curves of second-stage and first-stage cavitation. The method presented in the article is also suitable for treating cavitation tunnel data on nonducted propellers.

### 1. Introduction

References 1 and 2 introduce the use of regression analysis to treat results from open-water testing of ducted propellers. The regression equations derived were suitable calculations for the design of cavitationless propellers. However, treatment of cavitation tunnel data on propeller series is much more difficult than treatment of open-water data. This is because the shapes of the curves representing the cavitation tunnel data are somewhat more complex than those for open-water data (because when second-stage cavitation appears, thrust and torque decrease, and accordingly the cavitation experiment curve bends). Even more important is the fact that this curve must have been subject to certain constraints; that is, the no-cavitation and first-stage cavitation curves should coincide with the atmospheric pressure curve, while as soon as second-stage cavitation begins, the propeller thrust and duct thrust and torque begin to drop, and it is at this time that the cavitation curve begins to diverge from the atmospheric pressure curve, as seen in Figure 1. Accordingly, the problem



**Figure 1.** Experimental propeller thrust curves for atmospheric pressure and first- and second-stage cavitation

- |      |                            |   |
|------|----------------------------|---|
| Key: | 1. Atmospheric pressure    | 4. First-stage cavitation                 |
|      | 2. Second-stage cavitation | 5. Point of onset of first-               |
|      | 3. Onset of second-stage   | stage cavitation ( $J_{MT}$ )             |
|      | cavitation ( $J_{PT}$ )    | 6. Atmospheric pressure,<br>no cavitation |

of the junction of the curves for these two cavitation stages arises. It can be seen from Figure 1 that for atmospheric-pressure, no-cavitation and first-stage cavitation, the propeller thrust, torque and duct thrust experimental curves have a similar shape to the open-water curves, showing a monotone and nearly linear decline. But because the thrust and torque drop during second-stage cavitation, the experimental curve is parabolic. It is rather difficult to use the same regression polynomial to express both of these different-shaped curves. As far as the writers are aware, a manual smoothing method has always been used both in this country and abroad to treat cavitation tunnel data for propeller series. For example, although regression analysis methods were first introduced for treating open-water data for the Holland B series of propellers, the cavitation data were still presented in graphic form with manual smoothing.<sup>2</sup> The writers have not yet seen any results from the use of regression analysis. Thus, not only does the drawing of smooth propeller cavitation characteristic curves in terms of such factors as propeller pitch ratio, cavitation number, advance coefficient and the like require an immense amount of computation and plotting time, but only manual computation methods can be used in problems of the design of cavitating propellers. In view of these shortcomings, we have made an attempt to use regression analysis to treat cavitation data from ducted propeller series. The method presented here and a computer program based on it have already been used to process some

cavitation tunnel data on ducted propeller series.<sup>3</sup> The regression formulas derived are suitable for computer use in cavitation comparison tests and the design of cavitating propellers.

## 2. Regression Analysis of Experimental Data for Atmospheric Pressure and the Point of Onset of First-Stage Cavitation

### A. A Regression Formula for Treating Atmospheric-Pressure Data

Just as in the treatment of open-water test data, the experimental data for cavitation tunnel tests of ducted propellers such as propeller thrust, duct thrust and torque are converted to the dimensionless coefficients  $J$ ,  $K_{TP}$ ,  $K_{TD}$ , AND  $10K_Q$ . Using these dimensionless coefficients for each cavitation number, and input data regarding the observed point of onset of first-stage cavitation (point of onset of tip vortices) in cavitation tunnel tests of the ducted propellers (the experiment cavitation number is designated by  $\sigma$ , and the corresponding advance coefficient is designated by  $J_{MT}(P/D, \sigma)$ <sup>\*</sup>), the computer separates the experimental data into a cavitation region ( $J < J_{MT}$ ) and a noncavitation region ( $J > J_{MT}$ ), as shown in Figure 1. Then, the experimental data for the noncavitation region for each propeller and each cavitation number are matched with the corresponding data at atmospheric pressure, the screw pitch ratio  $P/D$  is taken as the independent variable  $x$ , the advance coefficient  $J$  as independent variable  $y$ , and  $K_{TD}$ ,  $K_{TP}$  and  $10K_Q$  as dependent variables, and the multivariate polynomial regression formula of Figure 2 is used to perform three bivariate polynomial regression analyses; the resulting regression polynomials for atmospheric pressure are:

$$K_{TD,c} = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} A_{ij}(P/D)^i(J)^j \quad (1)$$

$$K_{TP,c} = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} B_{ij}(P/D)^i(J)^j \quad (2)$$

$$10K_Q,c = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} C_{ij}(P/D)^i(J)^j \quad (3)$$

In these formulas, the subscript  $c$  indicates that the values are for atmospheric pressure; the same applies below. As in the open-water tests, from equations (1)-(3) it is possible to calculate and plot two-dimensional smooth ducted propeller characteristics for atmospheric pressure.

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\* Because of limited internal storage in the computer used, the method described in this paper does not take account of the disk area ratio.

## B. Regression Analysis of the Curve for Onset of First-Stage Cavitation

On the basis of observational data from cavitation tunnel tests of ducted propellers regarding the point of onset of first-stage cavitation, the advance coefficient  $J_{MT}$  can be substituted into equations (1) or (2) and the following equation:

$$C_{Th} = \frac{8}{\pi} \cdot \frac{K_T}{J^2} = \frac{8}{\pi} \cdot \frac{K_{T1} + K_{T2}}{J^2} \quad (4)$$

and the total thrust loading coefficient corresponding to the point of onset of first-stage cavitation, which is designated  $C_{ThT_1}$ , can be calculated.

Taking the screw pitch ratio  $P/D$  as the independent variable  $x$  and the inverse of the cavitation number, i.e.  $\sigma = 1/\sigma_1$ , as independent variable  $y$ , and  $C_{ThT_1}$  as the dependent variable, and carrying out bivariate polynomial regression analysis, we obtain a regression formula for the point of onset of first-stage cavitation in a ducted propeller:

$$C_{ThT_1} = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} D_{ij} (P/D)^i (\sigma_1)^j \quad (5)$$

From formula (5) we can calculate and plot curves of the point of onset of first-stage cavitation in a ducted propeller against the screw pitch ratio  $P/D$  and the cavitation number  $\sigma$ , as in Figure 2.

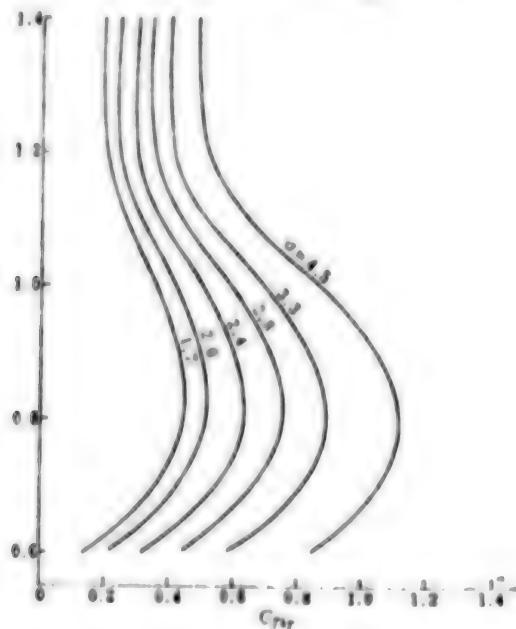


Figure 2. First-stage cavitation onset curves for ducted propeller.

### 3. Finding the Point of Onset of Second-Stage Cavitation

As stated in the introduction, the key to use of regression analysis to treat experimental data on cavitation tunnel tests of ducted propeller series is how to solve the problem of the junction of the curves for first-stage and second-stage cavitation. Accordingly, the position of the point of junction, i.e. a correct determination of the position of the point of onset of second-stage cavitation, directly affects the quality of curve fitting to the experimental results. Moreover, the position of this point has important reference value in propeller design. However, because the experimental data generally have random error, it is generally quite difficult by using manual plotting to derive its correct position and its patterns of change. Below, the writers will introduce a method for computer determination of the position of onset of second-stage cavitation. It treats  $K_{TD}$  and  $K_{TP}$  separately from  $10K_Q$ . We lay particular stress on showing the process by which we find the point of onset of second-stage cavitation which causes a drop in the propeller torque  $K_{TP}$ . First, we define the propeller torque drop coefficient  $K_1$  as:

$$K_1(P/D, \sigma, J) = \frac{K_{TP}(P/D, \sigma, J)}{K_{TP}(P/D, J)} \quad (6)$$

In this formula and henceforth, the subscript  $\sigma$  indicates that the quantity in question applies for a given cavitation number  $\sigma$ . It is clear from formula (6) that at the point at which propeller torque begins to drop (designated  $J_{PT}$ ), the propeller torque drop coefficient  $K_1$  is equal to 1. In the cavitation region between the point of onset  $J_{MT}$  of first-stage cavitation and the point of onset  $J_{PT}$  of second-stage cavitation, i.e. during the entire period of first-stage cavitation, there is no drop in the propeller torque, and accordingly the propeller torque drop coefficient  $K_1$  is equal to 1 throughout this period. Moreover, the experimental data invariably contain random error. Accordingly, it is rather difficult to use a manual plotting method for accurate location of  $J_{PT}$ , i.e. the point at which  $K_1$  begins to be strictly equal to 1. However, in general, it is relatively easy to determine accurately the point at which the thrust drop coefficient  $K_1$  is less than 1. We utilize the more accurate points at which  $K_1$  is less than 1 to find the point at which  $K_1$  begins to be equal to 1. Thus, from our experimental data in the cavitation region we use the propeller pitch ratio  $P/D$  as the independent variable  $x$ ,  $\sigma$  as the dependent variable  $y$ , the advance coefficient  $J$  as independent variable  $z$ , and  $K_{TD}$ ,  $K_{TP}$  and  $10K_Q$  as dependent variables, and carry out three-variable polynomial regression calculations. In this way we can perform smoothing of the experimental data in the cavitation region for the three coordinate directions of propeller pitch ratio, cavitation number and advance coefficient, and we can obtain the following regression polynomials:

$$K_{T_D} = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} \sum_{k=0}^{n_3} F_{ijk}(P/D)^i(\sigma_1)^j(J)^k \quad (7)$$

$$K_{T_P} = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} \sum_{k=0}^{n_3} F_{ijk}(P/D)^i(\sigma_1)^j(J)^k \quad (8)$$

$$10K_{\vartheta_0} = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} \sum_{k=0}^{n_3} G_{ijk}(P/D)^i(\sigma_1)^j(J)^k \quad (9)$$

From equations (2), (6) and (8), for each cavitation number for each propeller we can find rather precisely the advance coefficient at which the propeller torque drop coefficient  $K_1$  is equal to 0.85, 0.90, 0.95, 0.98 and 0.995 (the precision of the last point is slightly lower than that of the first four), and designate them as  $J_{PT_K}$  ( $P/D$ ,  $\sigma$ ,  $K_1$ ). Then, taking  $P/D$ ,  $\sigma_1$ , and  $K_1$  as independent variables  $x$ ,  $y$  and  $z$ , and  $J_{PT_K}$  as the dependent variable, and carrying out three-variable polynomial regression analysis, we can smooth the values of  $J_{PT_K}$  which we calculated from the various values of  $K_1$  for different cavitation numbers for different propellers in the three dimensions of pitch ratio, cavitation number and  $K_1$ , and can obtain the following regression polynomial:

$$J_{PT_K}(P/D, \sigma, K_1) = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} \sum_{k=0}^{n_3} H_{ijk}(P/D)^i(\sigma_1)^j(K_1)^k \quad (10)$$

Extrapolating from the small area of equation (10) (taking  $K_1 = 1$ ), we can obtain the advance coefficient  $J_{PT}(P/D, \sigma)$  at which the propeller thrust begins to decline for each cavitation number for each propeller, i.e.

$$\begin{aligned} J_{PT}(P/D, \sigma) &= \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} \sum_{k=0}^{n_3} H_{ijk}(P/D)^i(\sigma_1)^j(1)^k \\ &= \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} H_{ij}^*(P/D)^i(\sigma_1)^j \end{aligned} \quad (11)$$

where

$$H_{ij}^* = \sum_{k=0}^{n_3} H_{ijk} \quad (12)$$

Thus, for a given propeller pitch ratio  $P/D$  and cavitation number  $\sigma$ , from equation (11) we can calculate the advance coefficient  $J_{PT}(P/D, \sigma)$  at which the propeller thrust will begin to drop. When we vary  $P/D$  and  $\sigma$ , the calculated  $J_{PT}$  can be graphed to give a two-axis smooth curve of the

point at which propeller thrust begins to drop as a function of propeller pitch ratio and cavitation number; see Figure 3. If we substitute into equations (1), (2) and (4) the advance coefficient  $J_{PT}$  at which the propeller thrust begins to drop, calculated as described above, we can calculate the corresponding total thrust loading coefficient  $C_{Th,T}$ . If we take  $C_{Th,T}$  as the abscissa and  $P/D$  as the ordinate, and  $\sigma$  as a coefficient, we can plot a curve, usable in design, for the onset of second-stage cavitation based on the point at which propeller thrust begins to drop; see Figure 4.

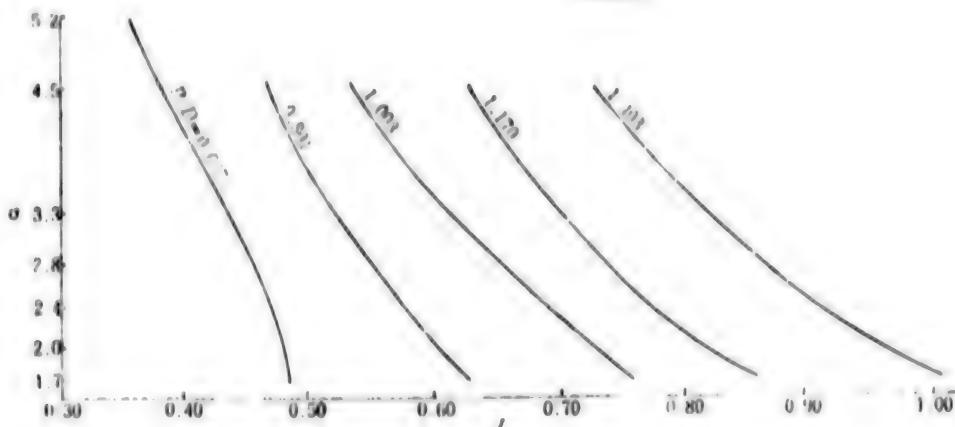


Figure 3. Curves for beginning of propeller thrust drop

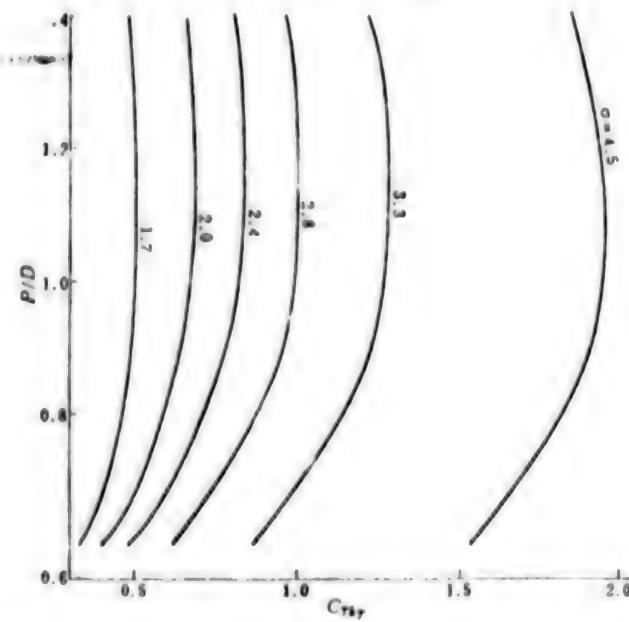


Figure 4. Ducted propeller second-stage cavitation onset curves ( $P/D-C_{Th,T}$ ) based on propeller thrust drop.

Similarly, we can introduce a coefficient  $K_2$  of propeller duct thrust drop and a coefficient  $K_3$  of torque drop:

$$K_1(P/D, \sigma, J) = \frac{0.15 + K_{TD_s}(P/D, \sigma, J) / \left( \frac{P}{D} \right)^4}{0.15 + K_{TB_s}(P/D, J) / \left( \frac{P}{D} \right)^4} \quad (13)$$

$$K_3(P/D, \sigma, J) = \frac{10K_{O_s}(P/D, \sigma, J)}{10K_{O_s}(P/D, J)} \quad (14)$$

(here the form of the definition of the duct thrust drop coefficient is slightly different from the definitions of propeller thrust drop and torque drop; the reason will be explained in section 4). Repeating the same process as was used for propeller thrust drop, we can obtain the advance coefficients  $J_{DT}$  and  $K_{QT}$  for the points at which the duct thrust and the torque begin to drop; their regression polynomials are:

$$J_{DT}(P/D, \sigma) = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} I_{ij}^*(P/D)^i (\sigma_i)^j \quad (15)$$

$$J_{QT}(P/D, \sigma) = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} J_{ij}^*(P/D)^i (\sigma_i)^j \quad (16)$$

From equations (15) and (16) we can calculate and plot two-dimensional smooth curves of the beginning of duct thrust drop and the beginning of torque drop against the propeller pitch ratio and cavitation number; see figures 5 and 6.

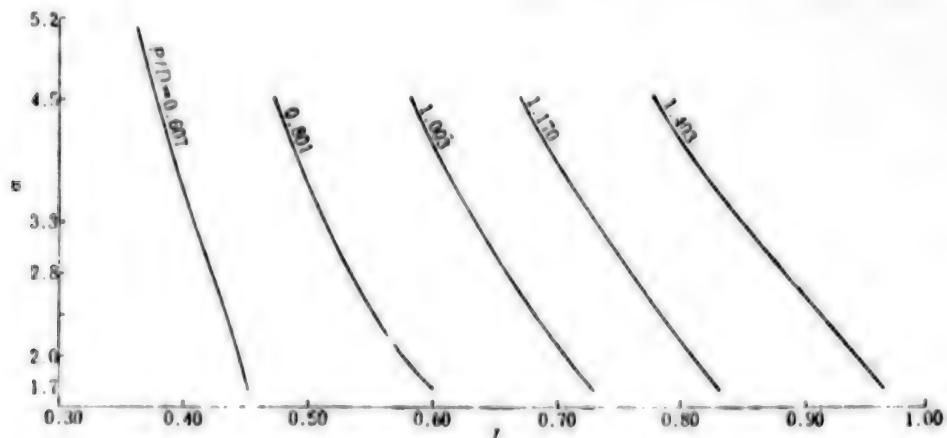


Figure 5. Curves for beginning of duct thrust drop

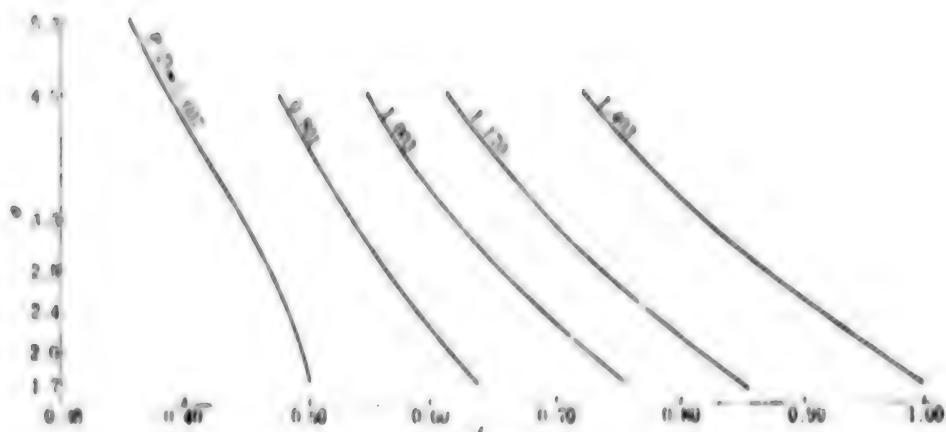


Figure 6. Curves for beginning of torque drop

Similarly, we substitute  $J_{PT}$  into equations (1), (2) and (4) and substitute  $J_{QT}$  into equations (3) and the following:

$$C_T = 16 \frac{K_0}{J^2} \quad (17)$$

Then we can calculate and plot the curves for the beginning of second-stage cavitation in a ducted propeller in terms of duct thrust drop and torque drop (no figure given).

The process of using regression analysis to find the point of onset of second-stage cavitation and the method of regression analysis of data on the point of onset of first-stage cavitation have already been used in treatment of cavitation tunnel data for several ducted propeller series. The positions of onset of first- and second-stage cavitation thus obtained show similar patterns to those in figures 2 and 4. If we convert the cavitation onset curves for the B-4 series propellers as plotted in reference 1 to a curve with  $C_{Th}$  as the abscissa and P/D as the ordinate and  $\sigma$  as a coefficient (see Figure 7), and compare this with figures 2 and 4, we can see clearly that the cavitation onset curves for the ducted and nonducted propellers follow different patterns. For the nonducted propellers, for certain cavitation numbers, the smaller the pitch ratio the better the cavitation qualities. For the corresponding ducted propeller, at a given cavitation number, there is an optimum pitch ratio for first-stage cavitation characteristics (i.e. the onset of tip vortices); but for second-stage cavitation characteristics (i.e. thrust drop), low pitch ratios are an unsuitable area, because for a small pitch ratio, at a given cavitation number, when the total thrust loading coefficient  $C_{ThT}$  is relatively small, there may be a drop in thrust (Figure 7).

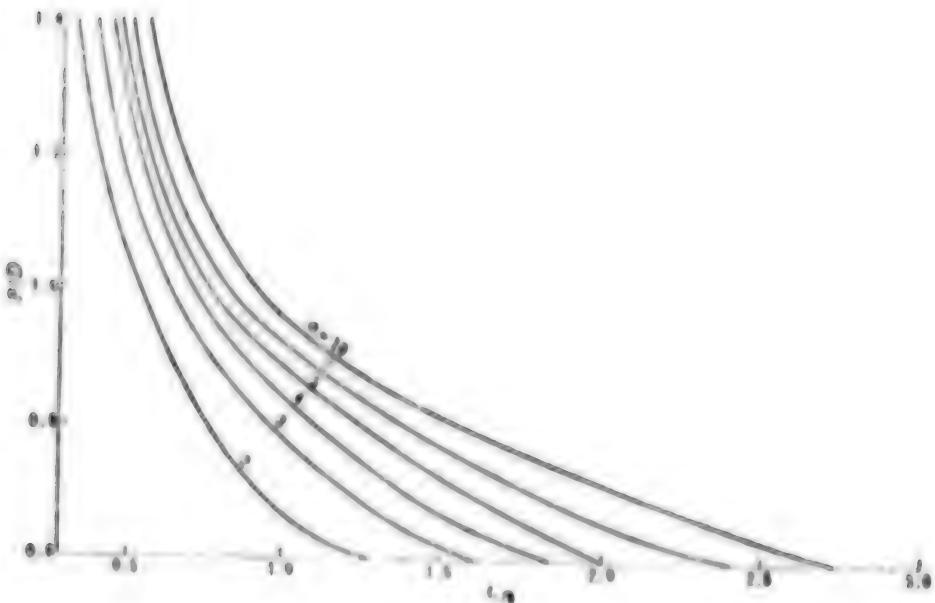


Figure 7. Cavitation onset curves ( $P/D - C_{Th}$ ) for B4-85 series propellers

#### 4. The Junction of the Curves for Second-Stage and First-Stage Cavitation

In this section using the propeller thrust coefficient  $K_{Tp}$  as an example, we will give an introduction to the use of regression analysis to handle the problem of the junction of the characteristic curves for second-stage and first-stage cavitation. For various cavitation numbers for various propellers, when in the cavitation region the advance coefficient satisfied the relation  $J_{PT}(P/D, \sigma) < J < J_{MT}(P/D, \sigma)$ , the propeller thrust will not drop, which is to say that within this region the propeller thrust with (first-stage) cavitation and that at atmospheric pressure are identical. Accordingly, experimental data within this range do not need processing, but can be used directly; the atmospheric pressure regression polynomial (2) can be used for the calculation. Accordingly, we only process the experimental data for  $J < J_{PT}(P/D, \sigma)$ . The main difficulty in processing experimental data in this region is the problem of how to join the characteristic curves for the two cavitation stages. That is, they are constrained by certain conditions, i.e. at the point  $J_{PT}(P/D, \sigma)$  for each cavitation number and each propeller, the value of  $K_{Tp}$  derived by processing with the regression analysis method must take on specific values (i.e. the propeller thrust coefficients at that point at atmospheric pressure). In the process of finding  $J_{PT}$  in the third section, although we conducted a three-variable polynomial regression on the data for  $K_{Tp}$  in the cavitation region, and did smoothing of the data in regard to pitch ratio, cavitation number and advance coefficient and obtained equation (8) expressing  $K_{Tp}$  at atmospheric pressure, in general this, equation cannot guarantee that at the point  $J_{PT}$  where propeller thrust drops, the characteristic curves of the two cavitation stages will join; in the vast majority of cases,

$K_{Tp_0}(P/D, \sigma, J_{PT}) \neq K_{Tp_c}(P/D, J_{PT})$ . Accordingly we must use a different method. Mathematically there can be two ways of processing experimental data of this kind with constraints. The first method is to use a multivariate regression analysis containing the constraints. But this kind of analysis is applicable only to treatment of cavitation tunnel data for one propeller, because in this case the constraints are few in number, being equal to the number of cavitation numbers taken on by the propeller during the test (generally 5 or 6). But for experiments on a series, when generally more than five models of propellers are tested, and the number of cavitation numbers taken on during testing of the series is generally about 10, there are too many constraints, and the ultimate regression polynomial must have more terms than there are constraints, so that in terms of both computer calculating speed and amount of internal storage it is infeasible. The second method is to find a family of known curves satisfying the constraints, which can be used as the basis of the multivariate regression analysis, and then to use ordinary regression analysis of multivariate polynomials without constraints to find the solution. The writers have used the second method to handle the problem of the junction.

If we start out from the propeller thrust coefficient  $K_{Tp}(P/D, \sigma, J)$ , it is rather difficult to find a family of known curves to satisfy the constraints. In this case, not only will the abscissa  $J_{PT}(P/D, \sigma)$  of the constraint points change with the propeller pitch ratio and the cavitation number, but in addition the abscissa  $K_{Tp_0}(P/D, \sigma, J_{PT}(P/D, \sigma)) = K_{Tp}(P/D, J_{PT}(P/D, \sigma))$  will also vary with these quantities. Accordingly, we must find a substitute for  $K_{Tp_0}$  so as to simplify the constraints. For this purpose we use the following "propeller thrust cavitation effect factor":

$$\Phi_p(P/D, \sigma, J) = 1 - K_t(P/D, \sigma, J) \quad (18)$$

Here  $K_t$  is the thrust drop coefficient defined in equation (6). Physically,  $\Phi_p$  expresses the degree of influence on the propeller thrust drop resulting from cavitation; a small value of  $\Phi_p$  indicates that the influence is small, and clearly  $0 < \Phi_p(P/D, \sigma, J) < 1$ . Thus, we find from equations (6) and (18) that for each cavitation number for each propeller, when  $J = J_{PT}(P/D, \sigma)$ ,  $K_{Tp_0}(P/D, \sigma, J) = J_{Tp_c}(P/D, J)$  are constraints, converting them to constraints on the cavitation effect factor  $\Phi_p$  we have

$$\Phi_p(P/D, \sigma, J) = 0, \quad \forall J = J_{PT}(P/D, \sigma) \quad (19)$$

Here, although the abscissa  $J_{PT}$  of the constraint points still varies with  $P/D$  and  $\sigma$ , the ordinate is a constant 0. Thus, it is rather easy to find a known family of equations which satisfy constraints (19). They are:

$$f_i = (P/D)^i (\sigma_i)^j (J_i)^k \quad i, j, k = 0, 1, 2, \dots \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \quad h = 1, 2, \dots \quad (20)$$

Here the succession of values of  $h$  as well as its correspondences with the exponents  $i$ ,  $j$  and  $k$  and the method of finding them are given in reference 2, and

$$J_1 = ((J_{cr}(P/D, \sigma) - J) + |J_{cr}(P/D, \sigma) - J|) / \left( \frac{P}{J} \right) \quad (21)$$

For a given pitch ratio  $P/D$  and cavitation number  $\sigma$ ,  $J_{PT}$  can be found from equation (11). It is easy to see from equation (21) that

$$J_1 = 0 \text{ when } J > J_{PT}(P/D, \sigma).$$

Accordingly, for any  $i$ ,  $j$  and  $k$ , the family of equations defined by equation (20) satisfies constraints (19). Taking  $P/D$ ,  $\sigma_1$  and  $J$  as the  $x$ ,  $y$  and  $z$  variables, and the propeller thrust cavitation effect factor  $\Phi_p$  as the dependent variable (where  $K_{TPC}$  is found by means of the atmospheric pressure regression polynomial (2)), the monomial defined by equation (20) is the basic function, and using the method of reference 2 to carry out three-variable polynomial regression, we can obtain the following regression polynomial for the propeller thrust cavitation effect factor:

$$\Phi_p(P/D, \sigma, J) = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} \sum_{k=0}^{n_3} L_{ijk}(P/D)^i(\sigma_1)^j(J_1)^{k+1} \quad (22)$$

From this we can find the propeller thrust factor under cavitation conditions. It is expressed by the formula

$$K_{TP} = \left[ 1 - \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} \sum_{k=0}^{n_3} L_{ijk}(P/D)^i(\sigma_1)^j(J_1)^{k+1} \right] \cdot K_{TPC}(P/D, \sigma) \quad (23)$$

We note that when  $J > J_{PT}(P/D, \sigma)$ , we have  $J_1 = 0$ , and we can infer that  $\Phi_p = 0$ ,  $K_{TP} = K_{TPC}$ . Accordingly, equation (23) is suitable for calculation of  $K_{TP}$  for all conditions.

Similarly, we can define a duct thrust cavitation effect factor:

$$\Phi_d(P/D, \sigma, J) = 1 - K_d(P/D, \sigma, J) \quad (24)$$

and a torque cavitation effect factor

$$\Phi_t(P/D, \sigma, J) = 1 - K_t(P/D, \sigma, J) \quad (25)$$

Here  $K_2$  and  $K_3$  are defined by equations (13) and (14). Their regression polynomials can be found to be

$$\Phi_d(P/D, \sigma, J) = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} \sum_{k=0}^{n_3} M_{ijk}(P/D)^i(\sigma_1)^j(J_1)^{k+1} \quad (26)$$

$$\Phi_t(P/D, \sigma, J) = \sum_{i=0}^{n_1} \sum_{j=0}^{n_2} \sum_{k=0}^{n_3} N_{ijk}(P/D)^i(\sigma_1)^j(J_1)^{k+1} \quad (27)$$

where

$$J_1 = ((J_m(P/D, \sigma) - J) + (J_{cr}(P/D, \sigma) - J)) / \left( \frac{P}{D} \right) \quad (28)$$

$$J_2 = ((J_m(P/D, \sigma) - J) + (J_{cr}(P/D, \sigma) - J)) / \left( \frac{P}{D} \right) \quad (29)$$

$$J_{cr}(P/D, \sigma) = \begin{cases} J_m(P/D, \sigma) & \text{when } J_{cr} \leq J_m \\ J_{cr}(P/D, \sigma) & \text{when } J_{cr} > J_m \end{cases}^* \quad (30)$$

The formulas for the duct thrust coefficient and torque coefficient under cavitation conditions are

$$K_{Tc}(P/D, \sigma, J) = (P/D)^2 \left\{ 1 - \Phi_0(P/D, \sigma, J) \right. \\ \times \left[ 0.15 + K_{Tc}(P/D, J) / \left( \frac{P}{D} \right)^2 \right] - 0.15 \left. \right\} \quad (31)$$

$$10K_{Qc}(P/D, \sigma, J) = (1 - \Phi_0(P/D, \sigma, J)) \cdot 10K_Q(P/D, J) \quad (32)$$

From equations (1)-(3), (21)-(23) and (26)-(32), we can calculate and plot three-dimensional smooth curves in terms of propeller pitch, cavitation number and advance coefficient and the characteristic curves for the point of onset of second-stage cavitation at the junction of the first- and second-stage cavitation curves (see figures 8-11). To save space on these graphs we give only the ducted propeller cavitation curve for one propeller pitch ratio.

There are certain points related to the above process of handling the junction of the first-stage and second-stage cavitation curves which require explanation. First, the equations for the duct thrust coefficient and cavitation effect factor and equation (31) are different in form from those for propeller thrust and torque. This is because the duct thrust coefficient is small, and can even become negative, so that if we define the duct thrust cavitation effect factor as  $\Phi_D = 1 - K_{TDc}/K_{TD}$ , we might encounter a case where  $K_{TD}$  is zero or is very small, so that in the computation process there might be an overflow or a very large fluctuation, as a result of which the regression analysis result would be poor. Accordingly, we add the term 0.15 to avoid the above problem. Moreover, as regards  $K_{TD}$ , when the difference between the values for high and low propeller pitch is rather large, generally when the propeller pitch is small, for all cavitation numbers  $K_{TD}$  has a deviation outside the standard deviation range of the regression method, so that if we take the data for all pitch ratios and subject them to regression analysis together, the pattern of the effect

\*  $J_{cr}(P/D, \sigma)$  is the point at which the total thrust begins to drop.

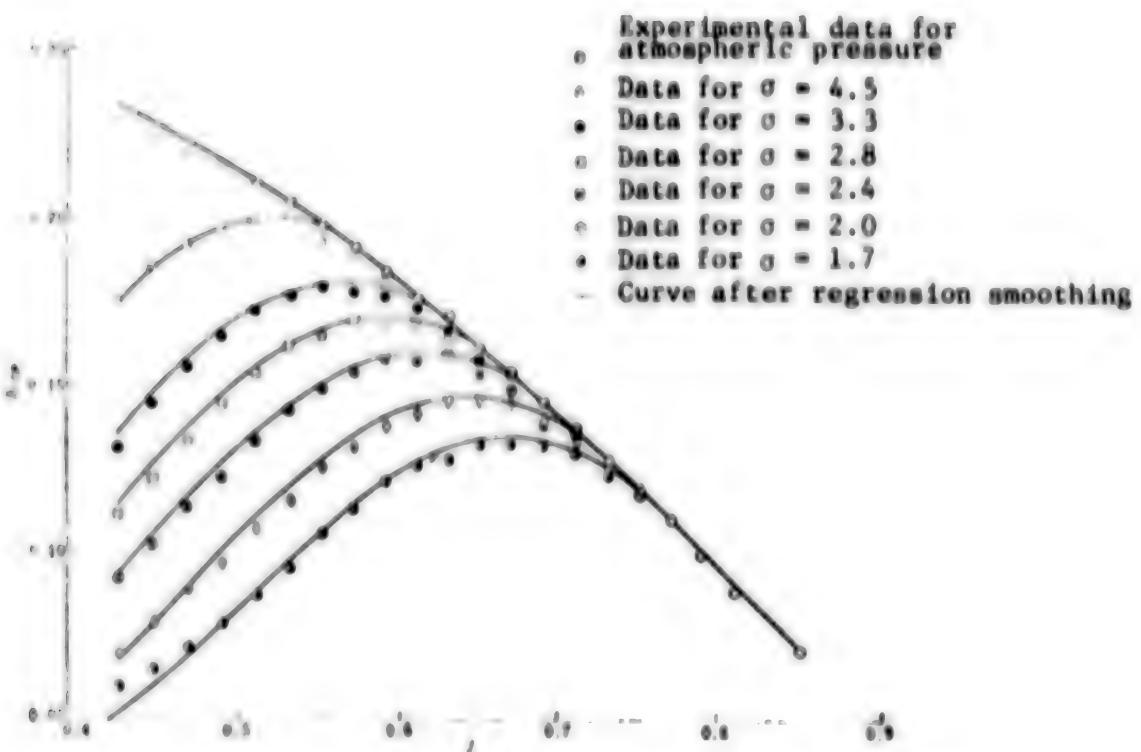


Figure 8. Ducted propeller cavitation characteristic curves:  $K_{Tp}$

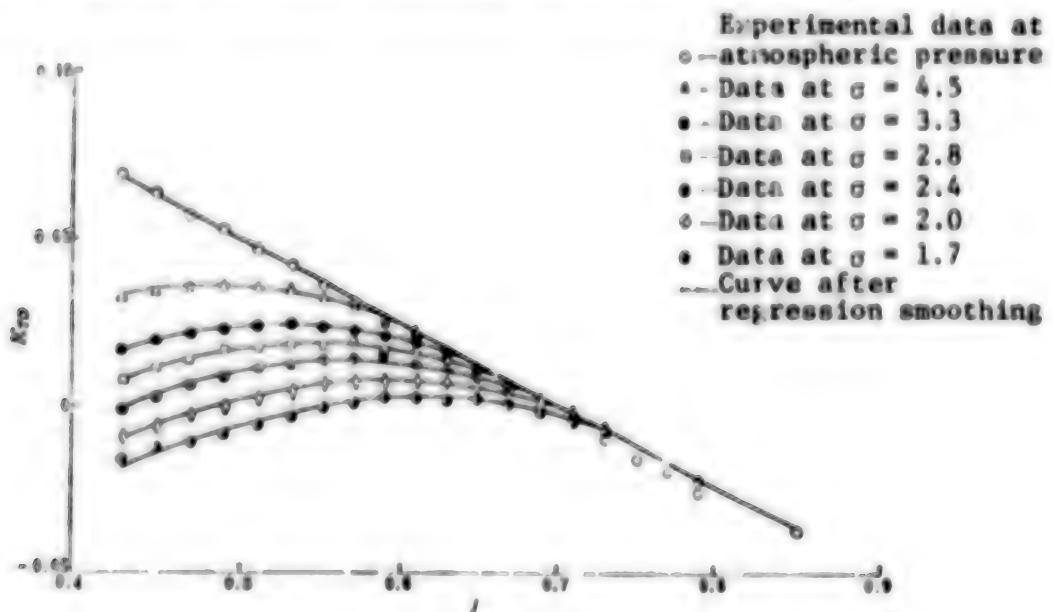


Figure 9. Ducted propeller cavitation characteristic curves:  $K_{Td}$

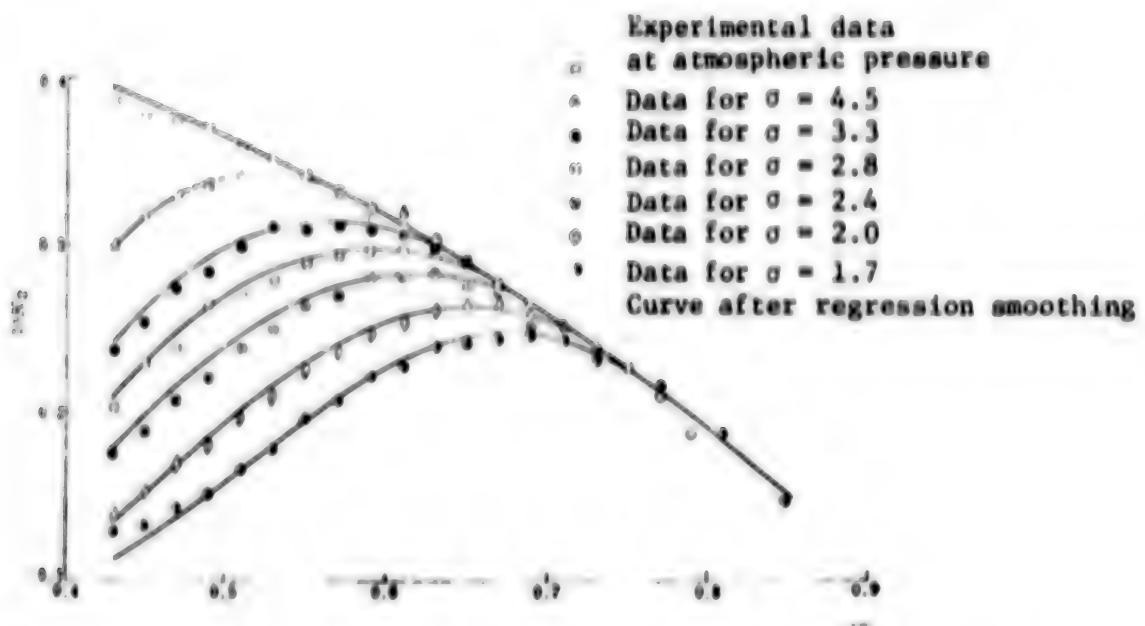


Figure 10. Ducted propeller cavitation characteristic curves:  $10K_Q$

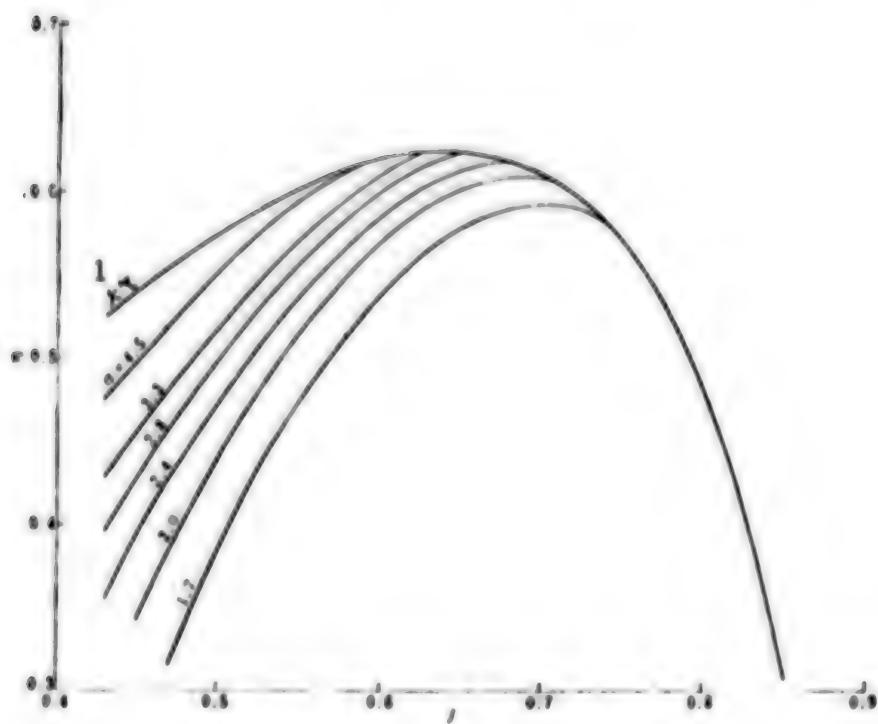


Figure 11. Ducted propeller cavitation characteristic curves:  $\eta$

of cavitation number on duct thrust for small pitch ratios may not show up. The introduction of the factor ( $P/D$ ) into equation (13) amounts to magnifying the data for small pitch ratios and decreasing the size of the data for large pitch ratios, so that their numerical difference will not be excessively large; this guarantees that after regression analysis that patterns of the effect of the cavitation number on the duct thrust for all pitch ratios will be visible. Second, in regression analysis of the torque cavitation effect factor, we assume that the first-stage and second-stage cavitation torque curves meet at the point  $J_{TT}(P/D, \sigma)$  at which the total thrust begins to drop. If we replace  $J_{TT}$  in equation (20) by  $J_{QT}$  and then carry out regression analysis of  $\Phi_Q$ , even though the variance of  $\Phi_Q$  and accordingly its ability to approximate the thrust experiment data are slightly improved, the efficiency curve begins to show a wave shape at the point at which efficiency begins to drop, and we cannot obtain a smooth efficiency curve like that in Figure 11. Third, at small cavitation numbers, because the experimental range is limited, within the experimental advance coefficient range, cavitation becomes established early, and the propeller thrust and torque curves and their corresponding atmospheric curves are already separate, so that there is no longer any question of junction of the first-stage and second-stage cavitation curves. For this kind of experimental data, we can use multivariate polynomial regression analysis without constraints.

## 5. Regression Analysis of the Results of Correction for Cavitation Tunnel Wall Effect

Theoretically, a ducted propeller's characteristics are the same for cavitation tunnel and open-water tests (within the range of experimental error). But in reality, experimental measurements for the two show a clear discrepancy, the primary reason for which is the cavitation tunnel wall effect. Accordingly, we need to make a correction for this wall effect so as to reconcile the cavitation tunnel results with those from open-water tests. There are many different types of tunnel wall effect correction methods: equalizing  $K_{Tp}$ , equalizing  $K_{TT}$ , equalizing  $C_{Th_p}$ , and equalizing  $C_{Th_T}$ .

These will not be discussed further here, but it is important to point out that the experimental data for every propeller at every cavitation number, regardless of which wall effect correction method is used, will show a different cavitation number after the correction. See, for example, the results of the correction made by equalizing  $C_{Th_T}$  in Table 1. For this kind of data, using the hand plotting method is rather complicated and troublesome, whereas there is no difficulty if the regression method is used; the approach is entirely similar to that in section 4. It is only necessary to replace all the variables with the new ones corrected for the wall effect and replace the atmospheric regression polynomial with the open-water regression polynomial (if the ducted propeller series open-water experimental data have already been treated by the regression method of reference 2), and calculate and plot cavitation onset curves and

Table I. Results of Tunnel Wall Correction for Certain Cavitation Numbers

D E M O N S T R A T I O N 1					D E M O N S T R A T I O N 2				
$\sigma$	$J$	$K_{TP_0}$	$K_{TB_0}$	$10K_D$	$\sigma^*$	$J^*$	$K_{TP_0}^*$	$K_{TB_0}^*$	$10K_D^*$
4.6	0.430	0.178	0.032	0.299	0.326	0.4018	0.1577	0.0477	0.2788
4.6	0.430	0.186	0.034	0.318	0.321	0.4204	0.1621	0.0505	0.2970
4.6	0.470	0.192	0.035	0.328	0.312	0.4394	0.1680	0.0522	0.3069
4.6	0.490	0.197	0.036	0.335	0.301	0.4585	0.1725	0.0534	0.3148
4.6	0.510	0.199	0.036	0.339	0.287	0.4777	0.1740	0.0533	0.3194
4.6	0.530	0.199	0.034	0.339	0.271	0.4971	0.1748	0.0533	0.3203
4.6	0.550	0.193	0.032	0.339	0.247	0.5168	0.1723	0.0501	0.3208
4.6	0.570	0.188	0.029	0.351	0.225	0.5366	0.1668	0.0474	0.3141
4.6	0.590	0.181	0.024	0.316	0.198	0.5566	0.1664	0.0429	0.3003
4.6	0.610	0.178	0.022	0.319	0.176	0.5765	0.1586	0.0406	0.3049
4.6	0.630	0.167	0.018	0.300	0.145	0.5969	0.1459	0.0350	0.2872
4.6	0.650	0.160	0.012	0.291	0.120	0.6171	0.1442	0.0307	0.2791

Key: 1. Data before correction

2. Data after correction

cavitation characteristic curves such as those in figures 2, 4 and 8-11. In this way it is possible to demonstrate fully the advantages of using the regression method for handling cavitation tunnel data for ducted propeller series.

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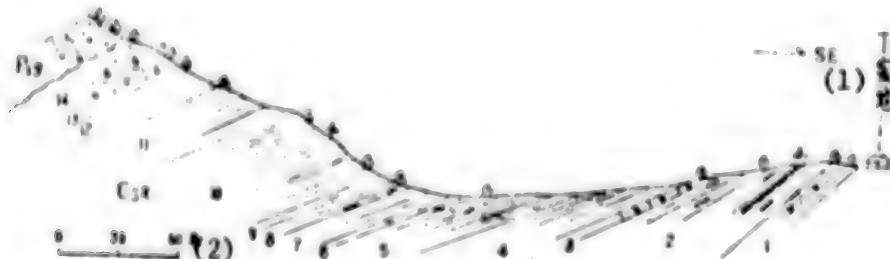
APPLIED SCIENCES

COAL BED OF LATE CARBONIFEROUS PERIOD DISCOVERED IN YUNNAN

Beijing DICENGXUE ZAZHI [ACTA STRATIGRAPHICA SINICA] in Chinese Vol 3 No 3, Sep 79 pp 193, 229

[Article by Gu Yinqu [7357 1758 3255]: "Discovery of the Coal Bed of the Late Carboniferous Period"]

[Text] When we were working in The Xiamidi region of Baliu Commune in Mojiang County in Yunnan Province, we discovered strata containing coal. These strata are visibly different from those of the Upper Carboniferous System of the Yangzi region and the south China region whether in the sedimentary phase or lithic composition. But it has similarities with the Taiyuan Group of the Upper Carboniferous System of the major coal containing strata of our nation's northern part. To differentiate it from the Maping group of the Upper Carboniferous System frequently seen in our nation's southern part, we call this set of coal containing strata the Xiamidi groups ( $C_{3X}$ ) of the Upper Carboniferous System.



Cross sectional diagram of the Xiamidi Group of the Upper Carboniferous System under Xiamidi of the Baliu Commune in Mojiang County, Yunnan Province

Key: (1) Meter (2) Xiamidi

The cross section begins from the edge of Xiamidi village, extends in the northwest direction along a small mountain valley upwards. Outcropping is good. It comes into nonconforming contact at a weak angle with the Qixia Group of the Lower Permian System which covers it. The relationship

between the two are clear. The bottom part of the cross section is connected to the middle Jurassic System on the east side by a fault and outcropping is not complete. The order of the strata of the cross section (see cross sectional diagram) from top to bottom is:

Upper Covering Strata: Qixia Group of the Lower Permian System: Grayish black biological limestone of *Pseudofusulina* sp. and *Stenopora* sp.

Xiamidi Group ( $C_3X$ ) of the Upper Carboniferous System:

14. The upper middle part consists of dark grayish calcic powdery sandstone with a medium layer of grayish white limestone and marl of glassy bodies, and is rich in *Pseudofusulina* species: *Quasifusulina* cf. *spatiosa* Sheng and fossils of brachiopods. The lower part consists of a mixed layer of a dark grayish medium layer of biological limestone and a grayish brown medium layer of calcic quartz and powdery sandstone rich in *Pseudofusulina* species: *Rugosofusulina* sp. and *Schwagerina* sp. 21.6 meters
13. Grayish muddy and powdery sandstone with dark gray marl glassy bodies, rich in lamella gilled lifeforms: *Pseudomonotis* cf. *hauni* (Meek et Hyden), *Sanguinolites* sp., *Leiopteria* sp., *Permophorus* sp. 4.7 meters
12. Dark grayish medium layer of fine muddy granules of quartz sandstone with a layer of powdery sandstone of light grayish sandy quartz about one meter thick. 7.5 meters
11. Grayish yellow thin to medium layer of fine muddy granules of quartz sandstone containing a black carboniferous streak rich in lamella gilled lifeforms: *Wilkingia?* sp., *Leiopteria* sp. and fossils of prolegged lifeforms. 28.8 meters
10. Dark grayish powdery sandstone of muddy quartz containing minute and fine water level marks and oblique layer marks with a thin layer of fine muddy granules of quartz sandstone, carboniferous shale and yellow mudstone streaks, containing small amounts of poor quality coal seams, and partially sandwiched in is a dark gray calcic powdery quartz sandstone nodules or glassy bodies, and rich in prolegged lifeforms *Naticopsis* sp., a rich store of lamella gilled lifeforms but poorly preserved; the sandwiched layer contains plant types of *Pecopteris* sp. 36.0 meters
9. Grayish fine muddy granules of quartz sandstone in this and medium layers. 3.3 meters
8. Black carboniferous shale with a sandwiched thin layer of dark grayish muddy and powdery sandstone and with occasional dark grayish calcic powdery sandstone of glassy bodies rich in lamella gilled lifeforms: *Nuculopsis* sp. and prolegged lifeforms *Naticopsis* sp. 6.4 meters

7. Thin grayish layer of fine muddy granules of quartz sandstone, with black carboniferous scales covering the surface of the layer. 11.0 meters
6. Thin dark grayish layer of calcic powdery quartz sandstone with sandwiched leaf shaped black carboniferous shale. 4.4 meters
5. Dark grayish calcic powdery quartz sandstone and black carboniferous shale of mixed and unevenly thick layers, with sandwiched coal seams and unstable and thin coal beds, also including small amounts of dark grayish calcic powdery quartz sandstone of glassy bodies. The central part is rich in fossils of lamella gilled lifeforms. 8.9 meters
4. Drab gray muddy and powdery sandstone in thin layers. 15.0 meters
3. Thin dark grayish layer of biological limestone rich in *Pseudofusulina* species: *Triticites* df. *subashiensis* Chang, *Quasifusulina* sp. and brachio-pods *chonetes* sp., *Dictyoclostus* sp. 4.0 meters
2. Black powdery and sandy carboniferous shale with sandwiched-in layers of irregular coal seams and thin coal beds. The coal seams are generally visible. At the middle and lower parts is a coal bed of 1.1 meters thick consisting of 4 layers of thin coal beds of about 20 centimeters thick and shale. It is rich in fossils of lamella gilled lifeforms and prolegged lifeforms. Shale contains plant lifeforms: *Sphenopteris* sp., *Pecopteris* sp. 24.8 meters
1. Grayish medium to fine granular muddy quartz sandstone and mixed dark gray muddy layers of feldspar and powdery quartz sandstone, with leaf shaped and streaks of black carboniferous shale, rich in lamella gilled lifeforms *Leiopteria* sp., *Nuculopsis* sp. and prolegged lifeforms *Meekospira* sp., *Naticopsis* sp. The bottom has not been seen. > 9.0 meters

This cross section has a total thickness of 185.4 meters. The lithic characteristics and the entire view of the biological groups show that it is mainly a lake facie with secondary facies of a shallow sea and coastal seas comprising an alternate land and sea facie containing coal sediments. It is comparable to the Taiyuan group of the Upper Carboniferous System of north China. The fossils of *Pseudofusulina* species indicate it should be a contemporary isofacie sediment of the Maping group of the Upper Carboniferous System of southern China. The book "China's Carboniferous Series" states: "In the eastern part of Yunnan, there is a particular place contemporary with the sediments of the Chuanshan group which also has thin metamorphic layers of limestone or black shale and its part occasionally contains a thin coal bed." But results of geological surveys of the regions of eastern Yunnan conducted by the Second Regional Survey Team of the Yunnan Geological Bureau prove that an earth stratum of the Late Carboniferous Epoch containing coal does not exist in the eastern regions

of Yunnan. Thus, the discovery of the coal containing stratum of the Late Carboniferous Epoch in the Mojiang Region has an important significance in the study of palaeogeography of the Late Carboniferous Epoch of southern China. It has also provided a new stratum for the search of coal resources in the western regions of Yunnan.

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## APPLIED SCIENCES

### 'TOBA COAL SERIES' OF XIZANG STUDIED

Beijing DICENGXUE ZAZHI [ACTA STRATIGRAPHICA SINICA] in Chinese Vol 3 No 3, Sep 79 pp 231-232

[Article by Zhang Lingxin [1728 6689 0207], Mu Xinan [1970 6007 0589], Son Dongli [1327 2639 4539] and Dong Deyuan [5516 1779 3293]: "New Understanding About the 'Toba Coal Series' of Qamdo, Xizang"]

[Text] The phrase "Toba coal series" was coined by Li Pu [2621 3877] (1955). It refers to the coal bed stratum of alternating sea and land facies of the Permian Period near Toba in Qamdo Prefecture in Xizang. Li Pu determined that the strata of coal series of the locality should belong to the Late Permian Epoch based on the fossils of plants and brachiopods found in the strata. This set of strata of coal series lies underneath the Anshan lava flow but its underlying geological stratum has not been discovered. Shen Jinzhang [4141 6855 4545] used Li Pu's data in the book "China's Permian Series" and called it the "Toba group." He believed that "whether viewed from its lithic nature or from the composition of the animal and plant fossils, it is very similar to the Longtan group of southern China. Thus, the Toba group should be equivalent to the Longtan group and the period should be the early period of the Permian Epoch."

Between 1970 and 1971, the Third Regional Survey Team of the Geology Bureau of Sichuan Province conducted geological surveys in Qamdo Prefecture, and conducted further studies of the Permian Series of the Toba region. The team actually measured the cross section of the strata and collected a rich collection of fossils. It was discovered that the Toba group's upper covering stratum of Anshan lava flow and the Jiapila group of the late Triassic Epoch are in nonconforming contact. It is in pseudo conforming contact with its underlying layer of the Jiaoga group of the early Permian Epoch. They include the Anshan lava flow within the Toba group with a total thickness of 1,930 meters. The period dates back to the early period of the late Permian Epoch.

Between 1970 and 1975, the second squad of the First Geological Brigade of the Xizang Geological Bureau carried out much geological work near Toba, and further classified the Toba group into an upper, middle and

lower section. The upper section contains mainly calcic sandstone and mudstone (shale) with a thin sandwiched layer of limestone and parts with glassy bodies of coal. It is rich in brachiopods and other fossils of sea facies and plant fossils. The middle section consists of sandstone, powdery sandstone, mixed layer of mudstone (shale), a sandwiched carboniferous mudstone (shale) and coal bed. It is rich in plant fossils. The lower section consists of mudstone with sandwiched powdery sandstone, sandstone and mixed layers of sandy mudstone (shale). The mudstone at the lower middle part is purplish red and of miscellaneous colors containing plant fossils. Its contact with the underlying stratum is unknown. They believe the Toba group belongs to the early period of the late Permian Epoch and they have named the upper covering of Anshan rocks "Xiayacun Anshan rock group" of the latter period of the late Permian Epoch. It is worth pointing out that the geological squad discovered fossils of *Pseudofusulina* species in the sandwiched limestone layer in the upper section of the Toba group and fossils were determined by the Nanjing Palaeontological Institute to be *Palaeofusulina* species. This discovery has provided new leads in determining the period of the Toba group.

In the summer of 1976, the geological group<sup>1</sup> of the Qamdo squad of the combined Qinghai-Xizang Plateau scientific survey team of the Chinese Academy of Sciences conducted observations of the geological strata of the Permian Period of Toba and collected fossils. At the top part of the Toba group (equivalent to the "upper section" named by the first brigade of the geological bureau of Xizang) were found an animal colony of *Palaeofusulina subcylindrica* Sheng, *P. Tobensis* sp. nov., *P. sp.*, *P. Fusiformis* Sheng, *Gallowaiinella jiaogensis* sp., nov. Except for the new species, *Palaeofusulina subcylindrica* is found in the Changxing group of the Upper Permian system of Qingshuichi in Yongan, Fujian Province, *P. Fusiformis* Sheng species is frequently found in the Changxing group of the upper part of the Upper Permian System in southern China and has been found in Kongdongschan in Datian, and Qingshuichi in Yonggan, Fujian; Meitian in Yizhang, Muhan, Zhangliangshan in Chongqing, Sichuan; Tong-i, Nankai in Shuicheng and Qinglong in Guizhou; and Leping in Jiangxi. The discovery of the animal colony of *Palaeofusulina* indicates that the top part of the upper section of the Toba group at Qamdo should belong to the Changxing stage of the late period of the Late Permian Epoch.

Because the upper section of the Toba group contains the animal colony of *Palaeofusulina* of the Changxing Period of the late period of the Late Permian Epoch, it is necessary to mark it out and establish a new stratigraphic unit in the original Toba group. The name "Kaxiangda group" is

1. Participants in the field work were comrades: Dong Deyuan [5516 1779 3293], Son Dongli [1327 2639 4539], Mu Xinan [1970 6007 0589], Zhang Qi [1728 3825], Liu Shiqun [0491 0013 0981], Wang Shengmo [3769 5116 2875]

Table 1. Evolution of the Periods of the 'Toba Coal Series' of the Late Permian Epoch at Toba in Qamdo

1) 1955	2) 1958	3) 1962	4) 1974	5) 1974	6) 1974	7) 1974	8) 1974	9) 1976	10) 1976	11) 1976	12) 1976
13)	14)	15)	16)	17)	18)	19)	20)	21)	22)	23)	24)
15)	16)	17)	18)	19)	20)	21)	22)	23)	24)	25)	26)
16)	17)	18)	19)	20)	21)	22)	23)	24)	25)	26)	27)
17)	18)	19)	20)	21)	22)	23)	24)	25)	26)	27)	28)
18)	19)	20)	21)	22)	23)	24)	25)	26)	27)	28)	29)
19)	20)	21)	22)	23)	24)	25)	26)	27)	28)	29)	30)
20)	21)	22)	23)	24)	25)	26)	27)	28)	29)	30)	31)
21)	22)	23)	24)	25)	26)	27)	28)	29)	30)	31)	32)
22)	23)	24)	25)	26)	27)	28)	29)	30)	31)	32)	33)
23)	24)	25)	26)	27)	28)	29)	30)	31)	32)	33)	34)
24)	25)	26)	27)	28)	29)	30)	31)	32)	33)	34)	35)
25)	26)	27)	28)	29)	30)	31)	32)	33)	34)	35)	36)
26)	27)	28)	29)	30)	31)	32)	33)	34)	35)	36)	37)
27)	28)	29)	30)	31)	32)	33)	34)	35)	36)	37)	38)
28)	29)	30)	31)	32)	33)	34)	35)	36)	37)	38)	39)

Key:

- 1. Li Pu et al 1955
- 2. Anshan lava flow
- 3. Upper Permian system
- 4. Toba coal series
- 5. Fault
- 6. China's regional stratigraphic table 1958
- 7. Upper Permian system
- 8. Upper part
- 9. Anshan lava flow
- 10. Lower part
- 11. Toba system
- 12. Lower Permian system
- 13. Requka Colony
- 14. Shen Jinzhang 1962
- 15. Anshan lava flow
- 16. Longtan Group
- 17. Toba Group
- 18. Lower Permian system
- 19. Requka Colony
- 20. Third regional survey team of Sichuan 1974
- 21. Upper Triassic system
- 22. Jiapila Group
- 23. Anshan lava flow
- 24. Longtan Group
- 25. Toba Group
- 26. Lower Permian system
- 27. Jiaoga Group
- 28. First geological brigade of Xizang 1976
- 29. Upper Triassic system
- 30. Jiapila Group
- 31. Xiaoyacun Anshan rock group
- 32. Upper Permian system
- 33. Toba Group
- 34. Upper section
- 35. Middle section
- 36. Lower section
- 37. Lower Permian system
- 38. This article
- 39. Upper Triassic system
- 40. Jiapila Group
- 41. Changxing Stage
- 42. Xiaoyacun Anshan rock group
- 43. Kaxiangda Group
- 44. Longtan Stage
- 45. Toba Group
- 46. Lower Permian system
- 47. Jiaoka Group

proposed to represent the sediments of the late period of the Late Permian Epoch in the Toba area of Qamdo. It shows a nonconformable contact with its upper covering Xiyacun Anshan rock group and a conforming contact with its underlying Toba group (Table 1). This article limits the definition of the Toba group stratum to the middle and lower sections to represent the sediments of the early period of the Late Permian Epoch.

The locality for the naming of the Kaxiangda Group is near the Kaxiangda Village in Toba, Qamdo. The lithic nature is a set of alternating sea and land facies of sandstone, mudstone (shale) and thin layer of limestone glauconitic bodies rich in animal fossils and plant fossils of sea facies. In addition to the above colony of Pseudofusulina animals, there are also: brachiopods<sup>1</sup> *Squamularia grandis* Chao, *Tyloplecta rossica* (Licharev), *Spinothyridina kueichowensis* Huang, *S. lopingensis* Kayser, *Meekella cf. kueichowensis* Huang, *Araxathyris* sp.; Plants<sup>1</sup> of *Sphenophyllum koboense* Roh., *Paracalamites stenocostata* Gu et Zhi, *Annularia pingloensis* (Sze) Gu et Zhi, *Fascipteris stena* Gu et Zhi, *Gigantopteris dictyophylloids* Gu et Zhi. Furthermore, there are also lamella gilled lifeforms, prolegged lifeforms, *Stenopora* sp. and stems of sea lily. The thickness is from 694 to 1,073 meters.

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1. The prolegged lifeforms were determined by Jin Yugan [6855 3768 3771], Sun Dongli [1327 2619 4539], the plants were determined by Li Xingxue [2621 2502 1331], Yao Zhongqi [1202 0340 1142] and Deng Longhua [6772 7893 5478].

APPLIED SCIENCES

BRIEFS

SHAANXI NAVIGATION SCIENCE--The people in Shaanxi have scored new achievements in the scientific research of navigation. The successful achievements, which have reached standards similar to those abroad, include navigation with the aid of satellites. [Xian Shaanxi Provincial Service in Mandarin 1400 GMT 26 May 80 HK]

SHANGHAI LASER RESEARCH--According to a station correspondent's report, (Wang Zhijiang), a Shanghai model worker and laser expert, has diligently studied the fundamental theory and technology of laser and has continuously scored new achievements. A pioneer of China's laser technology, (Wang Zhiliang) is the deputy director of the Shanghai optics and precision instruments department of the Chinese Academy of Sciences and director of the Shanghai Laser Technology Institute. He was responsible for designing China's first ruby laser instrument in 1962. Later on, he conducted some unique experiments in the research of high-energy and glass laser technology. In recent years, he has been enthusiastically teaching and studying laser holograms and optical information and has explored the application of holograms in social arts. Some of his achievements have reached advanced world levels. [Shanghai City Service in Mandarin 1130 GMT 27 May 80 OW]

SHANGHAI OCEANOGRAPHIC SHIP--The hull of "Experiment No. 3," a multi-purpose ship for conducting physical oceanic experiments, has been completed at the Hudong Shipyard in Shanghai. The ship is equipped with advanced gear such as satellite-guided navigational instruments and a 10,000-meter fathometer. The ship's instruments will be used to study oceanic geography, undersea topography, marine life, hydrology and undersea minerals. [OW090627 Shanghai City Service in Mandarin 1130 GMT 3 Jun 80 OW]

FUJIAN MICROSCOPIC LIGHT SOURCE--Fuzhou, 30 May--The military surgeons' academy of Fuzhou PLA units and the Fujian Provincial Film Machinery Plant have successfully studied and produced a new microscopic audio-visual educational instrument--the microscopic projection light source device with a halogen tungsten lamp. Its quality has reached an advanced level, and recently units concerned started production. The new instrument is used in medical and biological teaching and scientific research, and its principal use is for observation of tiny structures in human bodies and the cells of

creatures. Compared with the conventional microscope, the new instrument can be used for observation by 30 to 40 people at the same time with the structure of the cell tissue placed on the microscope enlarged by 400 to 1,600. [Beijing XINHUA Domestic Service in Chinese 0124 GMT 30 May 80 OW]

QINGHAI SOLAR ENERGY SOCIETY--Xining, 8 Jun--Qinghai Province has recently established the society of solar energy to explore the law of exploiting and utilizing the solar energy resources, conduct academic exchanges and popularize knowledge concerning solar energy. Qinghai is one of the areas in China where there are rich solar energy resources because of long hours of sunshine and strong solar radiation. Over the past several years, Qinghai has achieved remarkable success in the research into utilizing solar energy and has also trained many scientists and technicians. [OW090639 Beijing XINHUA Domestic Service in Chinese 0114 GMT 8 Jun 80 OW]

HUBEI COUNTY TECHNOLOGY--A short commentary on Hubei radio revealed that the people in Echeng County have done well in bringing in advanced technology from Shanghai and praised the county's good experience. There has been little investment with rapid results. Since 1980, many local industrial departments in Hubei have employed veteran workers from Shanghai because their experiences in technology and management are better. They have become important factors in the readjustment of the local industry in the province. [Wuhan Hubei Provincial Service in Mandarin 1100 GMT 31 May 80 HK]

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LIFE SCIENCES

LIVER TRANSPLANT REPORTEDLY SUCCESSFUL

Guangzhou NANFANG RIBAO in Chinese 26 Apr 80 p 2

[Article by correspondent He Yunteng [0149 6663 7506]: "Transplanted Liver Thriving in First Reported Instance in Our Province of Liver Transplant Operation"]

[Text] On 2 January this year, this newspaper reported the news of the successful liver transplant operation performed by medical personnel at the Provincial People's Hospital on Li Zanlin [7812 6363 2651], who suffered from cancer of the liver. This report aroused the attention of the broad masses of the readership. More than 4 months have passed since the operation. Is the patient beyond danger of tissue rejection? What is his health?

1.

Li Zanlin, a young member of the Chini Commune in Hua County contracted cancer of the liver and was scarcely able to eat anything. His life was in imminent danger.

On 8 December 1979, Provincial People's Hospital medical personnel performed a liver transplant operation on Li Zanlin. This is the first instance of liver transplant surgery in our province.

The chief surgeon undertaking this surgery was the deputy director of external medicine at this hospital, Li Chicheng [7812 6375 1004]. He skillfully cut the patient's peritoneum and a liver transformed by disease came into the view of all. Numerous nodules covered this liver. One nodular mass was as large as a fist; this was the liver cancer. Continuing, the doctors separated the veins and arteries with great meticulousness, and after several veins and arteries were blocked, the diseased liver was taken from the peritoneum. Another previously prepared liver from another body was carefully placed inside the patient's peritoneum.

Cutting out a liver is easy, but connecting a liver is difficult. This was the critical moment in the surgery. In connecting the veins in the cavity beneath the liver, the field of vision for the surgery was small,

and the walls of the veins were thin and fragile. A slight mismovement of the wrist and a tear could be made, and then the entire operation might fail. Doctor Li, slightly bent forward and fully intent on what he was doing, used a thread no bigger than a hair, sewing back and forth to join the ends of the blood vessels together. He inserted the needle quickly and drew it out gently, his movements skilled and careful. Each blood vessel was joined very smoothly without any leakage whatsoever.

After a tense fight against time and after the arteries had been joined, Doctor Li carefully loosened the blood vessel clamps and a surge of fresh red blood flowed into the newly transplanted ashen colored liver from another body. The new liver slowly became rosy. Half an hour later, a nurse responsible for keeping watch let out a little cry, "Some bile! Some bile!" Everyone turned their gaze at once to a dripping of bile from the bile duct, their faces wreathed in smiles. This bile was the fluid of life, and it showed that the transplanted liver had begun to recover its function.

## 2.

The use of transplanted organs to save the lives of incurably ill patients is an important stage in mankind's use of modern scientific techniques to triumph over illness. The first liver transplant in the world was performed by an American doctor in 1963. During the 1960's, doctors in our country performed these kinds of experiments, but experimentation was subsequently halted because of the enchainment of the spirit. It was not until 1978 that our country's first liver transplant surgery succeeded.

Li Chicheng is a doctor of external medicine trained after liberation. In battles day and night in hospitals, his surgical knife eliminated pain in numerous patients, but he had also been in contact with numerous patients with serious liver ailments. Each time he heard the groans of pain from patients seriously afflicted with liver disease, his mind could be no more tranquil than the roaring waves. When a people's doctor is unable to eliminate the suffering of the sick, how hard it is for him to bear! In order to save the lives of patients with serious liver ailments, he began 6 years ago to study the surgical techniques of liver transplants with other medical personnel in that field. He performed numerous experiments on animals, but for various reasons the experiments were dropped in the end.

After the smashing of the "gang of four," the spiritual fetters that bound people were destroyed. In 1978 he heard that two fraternal hospitals in Wuhan and in Shanghai had already developed liver transplant techniques. With the support of the hospital CCP Committee, he and several comrades went off together to study, and after they returned they began at once to perform experiments on animals. Following repeated experiments and exertions, the transplantation of liver in animals succeeded. This gave them tremendous encouragement and provided a good foundation for human liver transplants.

3.

With the victory in liver transplant techniques, a new battle began. Patients must be examined for signs of rejection reactions to the different tissue. This is at the crux of whether or not the person receiving the liver transplant will live for very long. In order to triumph over the tissue rejection, the medical personnel organized a special watch unit to watch over Li Zanlin day and night.

At the present time there are no fixed standards for determining tissue rejection. In order to catch indications of rejection at the earliest possible time, they adopted some effective therapeutic measures. Should some abnormal changes begin to appear in the patient, therapeutic diagnostic methods would be used, with the patient being dosed with small quantities of anti-rejection drugs. Improvement in the patient's condition following medication would verify a rejection reaction. In order to prevent syndromic infection and to achieve control of the rejection reaction, they did not follow the national and foreign experience of massive shock therapy. After repeated experiments, they used the minimum dosages of drugs to control the rejection reaction. They also used a combination of western and Chinese traditional methods, giving the patient some Chinese herbs to strengthen his constitution and protect the liver, which brought good results. Owing to the numerous effective measures used, the patient got through several rejection reactions without difficulty.

Now Li Zanlin has gained weight and both his appetite and his spirits are good. He has begun to recover the vitality of youth.

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## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

### BRANCH OF NATIONAL SCIENCE ACADEMY REOPENED IN WUHAN

Shanghai WEN HUI BAO in Chinese 1 Apr 80 p 1

[Article by Zhang Liang [1728 5328]: "Wuhan Branch of Chinese Academy of Science Reestablished"]

[Text] A plenary session was held by the Wuhan Branch of the Chinese Academy of Science on 28 March to celebrate the reestablishment of the branch and the restoration of its organization.

The Wuhan Branch of the Chinese Academy of Science was established in 1956. Scientific research organizations of five south-central provinces were combined in 1961, with the Central South Branch established. The Wuhan Branch became the Wuhan Office of the Central South Branch. During the Great Proletarian Cultural Revolution, Lin Biao and the "gang of four" maintained that scientific research units were the "hereditary realm of the capitalist class" and attempted to "run the institutes with open doors." Therefore, the Central South Branch and the Wuhan Office were suspended at the same time, and the research institutes were reassigned from urban to rural areas. After the National Science Congress, approval was granted by the State Council to prepare for the reestablishment of the Wuhan Branch, and various institutes had their organizations restored.

The newly established Wuhan Branch comprises the Institute of Hydrobiology, the Institute of Physics, the Institute of Rock and Soil Mechanics, the Institute of Virology, the Institute of Surveying and Geophysics, the Institute of Botany, and the Institute of Mathematics and Physics, as well as the Scientific Instruments Plant and Library. They have more than 500 scientific research personnel above the level of assistant researchers as their backbone.

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## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

### 'XINHUA' PROFILES PRC PHYSICIST HONORED BY SWEDEN

OW300240 Beijing XINHUA in English 0211 GMT 30 May 80

[Text] Beijing, 30 May (XINHUA)--Professor Huang Kun has been invited to become a foreign member of the Royal Swedish Academy of Sciences in the class for physics (III class). The solid state physicist is now director of the Institute of Semiconductors under the Chinese Academy of Sciences.

A graduate of the Physics Department at Yenching University in 1941, 61-year-old Huang Kun received his doctor's degree from Bristol University in Britain in 1947. He did research in the University of Edinburgh and the University of Liverpool between 1947-1951. He returned to China in 1951 to take part in socialist construction. He was appointed a professor of the Physics Department at Beijing University. In 1977, he became director of the Institute of Semiconductors under the Chinese Academy of Sciences.

Professor Huang Kun's contributions include the theory of impurity (defect) inducing x-ray diffuse scattering which he first proposed in 1947. It was experimentally confirmed in the 1970s and called "Huang diffuse scattering". It is now used internationally.

He proposed the quantum theory of multiphonon radiative and nonradiative transitions in 1950. It is considered a fundamental paper in modern research on spectroscopy of impurities (defects) in solid, luminescence and carrier recombination in semiconductors.

In 1951, he put forward the theory of the coupled vibrational mode between phonon and electromagnetic field, later known as polariton.

In collaboration with the German physicist professor Max Born, a Nobel laureate, he wrote a book titled "Dynamical Theory of Crystal Lattices" in 1954. This has been considered the authoritative work on this subject for more than two decades.

In 1958, he published with Professor Xie Xide, now vice-president of Fudan University, a book titled "Physics of Semiconductors". The book is widely used in Chinese institutions of higher learning.

The Royal Swedish Academy of Sciences now has 15 foreign members in physics who are all internationally distinguished scientists. Five are Nobel Prize winners.

## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

SHANGHAI SCIENTIFIC, TECHNICAL UNIVERSITY ENLISTS RESEARCH SCIENTISTS

OW181243 Beijing XINHUA in English 1225 GMT 18 Jun 80

[Text] Shanghai, 18 Jun (XINHUA)--The Shanghai Scientific and Technical University has invited 24 local scientists to become part-time professors or associate professors. The university last year invited eight scientists to accept leading posts at the university or department level.

The university sees cooperation with the research institutes as one way to improve teaching and scientific research. It has already established co-operation with nine research institutes in Shanghai. Among them are the Metallurgical Research Institute, the Silicate Research Institute, the Precision Optical Machinery Institute and the Institute of Technical Physics. All are attached to the Chinese Academy of Sciences.

Yan Dongsheng, director of the Silicate Research Institute in Shanghai, has become concurrently vice-president of the university. He organized some research workers at his institute to work with university's faculty members in editing teaching material.

The Electronics Optical Research Institute in Shanghai has helped give a series of lectures for advanced study in the university's physics department.

The university and the research institutes cooperate in training postgraduate students who cooperate in research projects.

CSO: 4020

## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

### RESEARCH INSTITUTES IN SHANGHAI EXPERIMENT IN AUTONOMY

Shanghai WEN HUI BAO in Chinese 2 Apr 80 p 1

[Article: "Obvious Advantages of Expanded Autonomy for Research Institutes"]

[Text] Nine research institutes, including the Shanghai Institute of Machinery Manufacture Technology, the Shanghai Institute of Synthetic Rubber, and the Shanghai Institute of Electron Optics, conducted an experiment in expanded autonomy in August of last year. What has been happening since then? Recently, the relevant municipal departments drew initial conclusions on the experiment in expanded autonomy by these nine units. The conclusions indicated that expanded autonomy in the research institutes was beneficial to correcting such conditions as "eating out of the big common pot," excessive concentration, and excessive control; beneficial to improving management organizations and intensifying the management of scientific research; beneficial to promoting an economic sense of responsibility, increasing the economic impact of technology, and correctly realizing the unity of profits of the country, the group and the individual; and beneficial to the motivation of a positive approach on the part of scientific and technical personnel to dig down into their potential for better performance of their mission of scientific research in order to contribute more to the nation.

During the experiment, various institutes formulated trial regulations concerning management of scientific research programs, finance, labor wages, awards and group welfare, equipment and materials, and the results of scientific research. Firstly, they have the responsibility of completing scientific research assignments handed down by higher authorities, and at the same time they are authorized to accept assignments other than those programmed, based upon the unit's technical capabilities and condition of equipment. In accepting this kind of assignment, a contract system will be used for charging a reasonable cost to the contractor according to the technical results. The Shanghai Institute of Machinery Manufacture Technology during its experiment conducted an analysis of the scientific research items assigned by higher authorities in 1979. It found that 30 of these items were not clearly defined as to their technical goals, object

of application, and source of funding. In the past, these items either dragged on for months or years or were discontinued before completion, thus creating a waste. Now that responsibilities and authorizations have been clearly defined, they will be able to contact the related departments and carry them out item by item according to plan. They will also positively accept assignments other than those programmed, based on the principle of unity between the planned economy and market readjustment. Thus, by the end of last year they had completed not only the programmed assignments but also seven assignments additional to those programmed. Secondly, they have the responsibility of meeting a definite revenue target, but at the same time they are authorized to apportion a certain share of the increased revenue which will be used to set up the fund for developing scientific research, group welfare, awards to employees and workers, etc., so that the economic gains of the country, the group and the individual will be combined better. The Institute of Machinery Manufacture Technology, the Institute of Synthetic Rubber, the Institute of Instruments and Meters, the Institute of Applied Electronics, and the Institute of Electron Optics increased their revenues last year to a total of more than 2.1 million yuan. Even after 60 to 80 percent of the money was retained by the units, a total of more than 600,000 yuan was handed over to higher authorities. Some of the departments in charge used the money collectively for achievement awards and for payments to those institutes which had little or no revenue, in order to solve some of the welfare problems for their employees and workers. Thirdly, they are experimenting with a cash award system, with the stipulation that those units that have completed their prescribed scientific research assignments or have reached a designated level of progress, or that have revenue in scientific research production exceeding the 1978 level, will be qualified to retain 30 percent of the increased revenue as funds for award to employees and workers. Institutes engaged in the experiment are also permitted to draw cash awards in advance during the third quarter of the year. Fourthly, they have the responsibility of doing a better job in assets inventory and auditing or in assets accounting so as to set up an operation and maintenance system for equipment and materials, and at the same time they are authorized to draw and use the fixed assets depreciation according to government regulations and are authorized to transfer or lease fixed assets with payment so as to gradually renew their equipment. It is also stipulated that institutes engaged in the experiment shall have the ownership (patent) of the end-product and shall be permitted to sell the end-product themselves.

The experiment showed that there are many advantages in expanding the autonomy of institutes, but there are still some problems to be solved. For example, at present the systems of scientific research institutions and scientific research control still cannot organize scientific research in accordance with the rule of scientific development and the rule of economy; there is not enough coordination between scientific research and production; and improvement in utilizing talented persons, control of labor wages, etc., is still not obvious. Therefore, the experiment in expanding the autonomy of research institutes should continue to be developed intensively and extensively. Firstly, the current system of scientific research

control should be consolidated. At present, the restructure of scientific research institutions should be grasped well so that normal scientific research discipline will be set up and implemented, the level of scientific research control will be reformed, and the system of scientific research control will be improved, thereby gradually changing the institutes into economic units with relative independence. Secondly, the contract system for scientific research should be extended. A parallel connection between research units and production units should be established through the contract system, thus getting rid of the present contradiction between scientific research and the demands of the national economy. In program control, the sole use of administrative measures should be changed so as to make economic methods the main factor, to be supplemented by administrative control. Thirdly, thinking should be further liberated so that autonomy will be expanded to management in the selection of talented persons and in their training, promotion, and advancement, and so that feasible methods for personnel management and labor wages beneficial to the selection of talented persons will be formulated. Fourthly, after the financial control system has been extensively changed to "fund contracted, remainder retained" and "retaining a portion of the increased revenue and the saved expenditures," as implemented this year, it is necessary to further strengthen economic control and reform the economic impact of technology in scientific research. Following the principle of ensuring that scientific research is the main factor, units engaged in applied research and development research should expand medium-scale trial production and small-lot production, endeavor to see to it that scientific research leads production and production feeds scientific research, and strive for self-responsibility for profits and loss. In this way, institutes will become enterprise-oriented.

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CSO: 4008

## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

### BIOGRAPHIC INFORMATION ON SCIENTISTS

[The following biographic information on selected scientists was extracted from various Chinese-language publications as indicated in parentheses at the end of each item.]

Chen Jia [7115 0857], Prof.

Director, Institute of Foreign Literature, Nanjing University. (Beijing GUANGMING RIBAO 7 Jun 80 p 2)

Li Shanbang [2621 6365 6721]

Noted seismologist; member of the board of directors, China Seismological Society; senior researcher at the Institute of Geophysics, State Seismological Bureau; died on 29 April 1980 in Beijing at age of 79; a memorial service was held at Babaoshan Revolutionary Cemetery in Beijing on 6 May. (Beijing GUANGMING RIBAO 23 May 80 p 3)

Li Zhensheng [2621 2182 5116]

Deputy Director, Northwest Institute of Botany; recipient of a National Science Congress Award for developing a new strain of disease-resistant wheat. (Beijing GUANGMING RIBAO 21 Apr 80 p 2)

Lin Ling [2651 0407]

Vice President, Sichuan Provincial Academy of Social Sciences; author of an article on enterprises' self-determination and management reforms. (Beijing RENMIN RIBAO 9 May 80 p 5)

Mao Yisheng [5403 0110 0581]

President of the Scientific Research Academy [Kexue Yanjiuyuan 4430 1331 4282 4496 7108], Ministry of Railways, which was founded 1 March 1950; attended a tea party to mark the 30th anniversary of its founding on 1 March 1980. (Beijing GUANGMING RIBAO 2 Mar 80 p 1)

Wu Wenjun [0702 2429 0193]

Deputy Director, Institute of Systems Sciences, Chinese Academy of Sciences; recently was admitted to the CCP at a party branch meeting held in Beijing. (Beijing GUANGMING RIBAO 23 Apr 80 p 2)

Wu Xuezhou [0702 1331 0719]

Director, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences; elected vice chairman, Standing Committee of Jilin Provincial People's Congress at the Second People's Congress held 30 March to 5 April 1980. (Hong Kong ZHONGGUO XINWEN 9 Apr 80 p 7)

CSO: 4008

Biochemistry

AUTHOR: WANG Yunfu [3076 0061 0046]

ORG: Institute of Biophysics, Chinese Academy of Sciences

TITLE: "Research on Spatial Frequency Characteristics of a Mathematical Model of the Retinal Receptive Fields"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 1-10

TEXT OF ENGLISH ABSTRACT:

The characteristics of spatial frequency of our previously proposed mathematical model of the retinal receptive fields are investigated. First of all, the model is simplified, assuming that the weight function  $K(x)$  is the difference between two normal distributions, then Fourier transformation of this function is made, followed by discussion on the characteristics of the function based on the spatial frequency component. The results have showed that the function  $\Lambda(\omega)$  is also the difference between two normal distributions, but variance and peak value in each term are different. Generally speaking, certain correction may be made from  $K(\omega)$  with respect to an input pattern. Differentiating  $K(\omega)$ , the frequency value  $\omega^*$  may be obtained, at this value  $\omega^*$

|Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO, Vol 11, No 1, Mar 79  
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the  $K(\omega)$  arrived maximum. The condition inhibiting direct current component is found. The effect of disappearance of peripheral inhibitory area in receptive field is discussed. Finally, the relationship between the simplified model of the retinal receptive field and the lateral inhibitory neuronal network is explored.

Thanks are due colleague Qi Xiangli [7871 5046 2651] for providing the bibliography. Received 29 May 1977.

AUTHOR: None

ORG: Wuxi Nuclear Medical Institute, Suzhou Medical College, Wuxi 5th Pharmaceutical Factory and Wuxi Institute for Drug Control

TITLE: "The Metabolism of NaHSO<sub>3</sub>-Andrographolide Studied by Means of <sup>35</sup>S

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 11-18

TEXT OF ENGLISH ABSTRACT:

The metabolism of NaHSO<sub>3</sub>-andrographolide in rats was studied by means of NaHSO<sub>3</sub>(<sup>35</sup>S)-andrographolide.

The compound was labeled at the 12th C atom of andrographolide with NaHSO<sub>3</sub>(<sup>35</sup>S) solution by additive reaction. The efficiency of labelling was 92%.

The samples of urine and stool of the animal were taken at definite intervals. The samples of C. N. S. and viscera were taken from sacrificed animal after intravenous injection in the tail.

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79 pp 11-18]

The radioactivity of these samples was determined in a liquid scintillation counter. The metabolism of the labeled compound in the rat's body showed that in the C. N. S. the compound mainly accumulated in the spinal cord. The accumulation was of the descending type. It could probably lead to dilatation of the peripheral vessels and reduction of the muscular tone, thus in turn lowering down the body temperature.

In viscera, it chiefly accumulated in the duodenum and rectum. This fact might explain why this drug was used for the treatment of enteritis and bac. dysentery.

This drug could be absorbed and excreted rapidly. About 86.2% was excreted in 72 hrs. after injection. So the clinicians are advised to increase the dosage or shorten the interval of administration.

Because most of the NaHSO<sub>3</sub>(<sup>35</sup>S)-andrographolide is chiefly unchanged excreted in the urine, we considered it might be effective in the treatment of urinary infection.

Thanks are due Li Jingfan [2621 2529 0416] of Isotope Division, Institute of Atomic Energy, Chinese Academy of Sciences for providing assistance.

Received 27 August 1977.

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TITLE: "Studies on Snake Venoms and Their Utilization. III. The Action of the Venom of *Agkistrodon Halys* (Pallas) on Blood Coagulant System"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 19-24

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79 pp 19-24]

TEXT OF ENGLISH ABSTRACT:

The action of the venom of *Agkistrodon halys* (Pallas) on blood coagulant system both in vitro and in vivo was studied. The experiment suggests that there are at least two anticoagulant principles in the venom of *Agkistrodon halys* (Pallas). They are anti-thromboplastin and plasmin-like substances.

Received 12 October 1977.

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ORG: Shanghai Institute of Biochemistry, Chinese Academy of Sciences

TITLE: "Concentrating Effect in Polyacrylamide Gel Electrophoresis and the Separation of Baker's Yeast tRNA"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 31-36

TEXT OF ENGLISH ABSTRACT:

A new kind of polyacrylamide gel electrophoresis, current density gradient gel electrophoresis(CDGGE), has been developed. CDGGE shows good concentrating effect not only at the beginning of electrophoresis, but also during the run. Moreover, with the continuous system employed in CDGGE, possible harmful effects resulting from discontinuities are avoided.

Unfractionated Baker's yeast aminoacyl tRNAs were resolved into 20 bands by CDGGE. Some of them have been identified by dansylation of the amino acid and locating the fluorescent spots on polyamide sheets.

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79 pp 31-36]

Thanks are due Shen Sixiang [3088 1835 4382] and Lu Youyi [0712 1635 0308] for work participation and enzyme measurement; Luo Shanshan [5012 3790 3790], Qi Zhengwu [2058 2973 2976] and Zhou Yuancang [0712 0337 5115] for isolation and determination of amino acids; as well as Luo Shanshan, Qi Zhengwu [2058 2973 2976] and Zhou Yuancang [0712 0337 5115] for their present of specimens.

Received 18 January 1978.

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TITLE: "Agarose-Gel Electrophoresis and Its Application to the Separation  
and Classification of Human Serum Lipoprotein"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET  
BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 37-49

TEXT OF ENGLISH ABSTRACT:

A simple method of preparing agarose gel suitable for immuno-electrophoresis and serum lipoprotein electrophoretic separation has been developed.

By using a dialyzing membrane treated with alcohol as the supporting material for agarose gel electrophoresis a colorless transparent background has been obtained. This transparent agarose gel electrophoretogram is excellent for optical scanning, thus the percentage of each lipoprotein component in the electrophoretogram can easily be measured.

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79  
pp 37-49]

With this self-prepared agarose gel it is possible to separate serum lipoproteins in the presence of albumin into five clearly cut bands. The five major bands are chylomicrons,  $\beta$ -lipoprotein, pre- $\beta_2$ -lipoprotein, pre- $\beta_1$ -lipoprotein and  $\alpha$ -lipoprotein. Besides, there have appeared infrequently two other fractions, a very slowly moving pre- $\beta_3$ -lipoprotein and pre- $\alpha$ -lipoprotein. It is, therefore, possible to classify the lipoprotein electrophoretograms according to the number and the rate of mobilities of the pre- $\beta$ -lipoprotein, the intensity of the color of each band and the presence of chylomicrons into eight types, namely, I, II<sub>1</sub>, II<sub>2</sub>, II<sub>3</sub>, II<sub>4</sub>, III, IV, V, each with its distinctive characteristics.

The densitometry scanning determination of agarose gel lipoprotein electrophoretogram has given good results and satisfactory repetitions, so that a quantitative determination of each lipoprotein component can very easily be made.

Received 20 January 1978.

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ORG: CAI, JIN, ZHAO, RONG of the Zhongshan Memorial Hospital, Shanghai First Medical College, CHEN of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences

TITLE: "A Micro-Fluorescent Method for the Determination of Free Amino Acids in Human Serum"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 51-56

TEXT OF ENGLISH ABSTRACT:

O-phthaldehyde is used for the determination of free amino acids in human serum by measuring the fluorescence produced by its reaction with the  $\alpha$ -amino group of amino acids. The method is so sensitive that as little as 1-0.1 nmole of amino acids or

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79 pp 51-56]

5 to 10  $\mu$ l of serum is sufficient for one test. This method is simple, rapid and accurate, free from the interference of other nitrogenous compounds present in serum, such as urea, uric acid, creatinine and ammonium salts.

The average value of free amino acids in human serum from 52 normal persons calculated from the standard curve of glutamic acid is  $3.95 \pm 0.63$ (S. D)mg% or  $2.83 \pm 0.45$ (S. D)mmole/l.

This method is suitable for clinical survey and laboratory research.

Received 5 February 1978.

AUTHOR: LIU Wangyi [0491 2598 1138]  
GU Xiangrong [6581 4382 2837]

ORG: Both of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences.

TITLE: "Micromethods for Sequencing Ribonucleic Acids"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 57-65

TEXT OF ENGLISH ABSTRACT:

The synthetic methods for two fluorescent reagents and fluorescent hydrazones of nucleoside dialdehydes and of 5'-methylene nucleoside dialdehydes have been described in detail.

Hydrazination of 1-dimethylaminonaphthalene-5-sulphonyl-glycol ethyl ester with hydrazine gives the fluorescent reagent I, 1-dimethylaminonaphthalene-5-sulphonyl-glycolhydrazone (DNS-Gly-NHNH<sub>2</sub>); whereas the fluorescent reagent II, 1-dimethylaminonaphthalene-5-sulphonylhydrazone (DNS-NHNH<sub>2</sub>) is obtained from direct hydrazination of 1-dimethylaminonaphthalene-5-sulphonyl chloride with hydrazine.

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79 pp 57-65]

The reaction of DNS-Gly-NHNH<sub>2</sub> with the nucleoside dialdehydes and the 5'-methylene nucleoside dialdehydes produced by oxidation of the corresponding nucleosides and the 5'-nucleotides with sodium periodate leads to the formation of the respective fluorescent hydrazones.

The fact that the reaction of DNS-Gly-NHNH<sub>2</sub> with acetone or benzaldehyde yields respectively DNS-glycol hydrazone of acetone or DNS-glycol hydrazone of benzaldehyde indicates that these fluorescent reagents may be used to determine any ketone or aldehyde groups other than nucleoside dialdehydes.

The preliminary results of this work have been published previously.

Thanks are due Professor Wang Debao [3769 1795 1405] for providing counsel, and Lin Nanqin [2651 0589 3830] and Zhu Baozhen [6175 1405 3791] for element analyses.

Received 3 March 1978.

AUTHOR: None

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TITLE: "Measurement of Lymphocyte Transformation in Vitro Using Tritiated Thymidine I. Comparison of Two Kinds of Home-Made Fiber Filter Discs"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 67-72

TEXT OF ENGLISH ABSTRACT:

In the determination of  $^3\text{H}$  thymidine uptake of transformed human lymphocytes on solid supports,  $^3\text{H}$  glass fiber disc was found to give better counting efficiency and reproducible results than the millipore filter.

When glass fiber discs were used for either isolated lymphocyte or whole blood culture assay, better results were obtained when using distilled water for washing, 5% trichloroacetic acid for destroying cells and precipitating DNA, and absolute ethanol for dehydration and decolorization.

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79 pp 67-72]

The counts were significantly increased when the glass fiber discs were attached to the wall of the counting vial with 0.2 ml of scintillator mixture, as compared with the conventional method of placing the discs at the bottom of the vial containing 5 ml of scintillator mixture. However, care should be taken to avoid the rotation of the vial in the rotatory counting vial carrier in order to minimize the counting error, since changes in the geometrical angle between the disc and the photomultiplier would influence the count considerably.

Thanks are due to the Central Isotope Laboratory, Shanghai First Medical College for isotope measurements.

Received 24 March 1978.

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DAI Zhiqiang [0108 1807 1730]  
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TITLE: "Studies on Nuclear Envelope. I. The Quantitative Ultrastructural Analysis of Nuclear Envelope in Several Experimental Tumor Cells"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 73-78

TEXT OF ENGLISH ABSTRACT:

Nuclear envelope (NE) surrounding the periphery of the nucleus of interphase eukaryotic cells, is one of the characteristic biomembrane systems. It has been known that the contour of the nucleus of some malignant cells was not regular, and the perinuclear cisternae as well as the internal dense lamillæ was thicker than that of the normal cells. These phenomena, however, are still lacking the quantitative informations.

In this paper, the quantitative differences of the ratio of the surface area of NE to the volume of the nucleus (Sn) between the normal and tumor cells were

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79 pp 73-78]

demonstrated by the method of "Cytomorphometric Analysis". The data indicated that Sn of ascitic hepatoma cells in the 8th day after inoculation was significantly greater than that of the normal liver cells by 40%. In other tumors including both the ascitic and solid forms of Sarcoma 180 and Melanoma, Sn values were also higher than that of normal liver cells. While on the 2nd day after inoculation, ascitic hepatoma cells did not show the greater value of Sn. It suggested that the increase of transportational function of NE was associated with the proliferative status of the malignant cells. And it was found that the total thickness of NE had no significant difference between the normal and experimental tumor cells. Vincristine & Homoharringtonine have not demonstrated significant affection in these experiments, though the former induced slight lowering of Sn and thickness of NE of Sarcoma 180.

Thanks are due Gong Zuxun [7895 4371 1053] of Shanghai Institute of Biochemistry, Chinese Academy of Sciences for providing valuable counsel.

Received 1 April 1978.

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LIU Nianjuan [0491 1628 1227]  
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TITLE: "Studies on Immobilized Polynucleotide Phosphorylase I. The preparation of Immobilized Polynucleotide Phosphorylase and Its Properties"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 79-87

TEXT OF ENGLISH ABSTRACT:

Polynucleotide phosphorylase (PNPase) from *E. coli* 1.183 was coupled to diazotized p-aminobenzenesulphonyl ethyl (ABSE) agarose. Its activity recovery and stability were superior to those of PNPase immobilized on ABSE-Sephadex G-200 and ABSE-cellulose.

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79  
pp 78-87]

Upon immobilization, the optimum pH for the polymerization shifted from 9.6 to 10. The free enzyme showed maximum activity at 47°C, whereas the optimum temperature of the immobilized enzyme became rather broad, between 42~52°C. The apparent  $K_m$  of the immobilized enzyme was same as the free enzyme. The immobilized enzyme appeared to be more heat stable than the free enzyme. After treatment at 57°C for 30 min, the retained activity of the immobilized enzyme was 72% while that of the free enzyme was 22%.

Received 1 April 1978.

AUTHOR: some

ORG: The Virus Research Group, Shanghai Institute of Biochemistry, Chinese Academy of Sciences; The Research Group of Wheat Disease, Hebei Institute of Plant Protection, Soil and Fertilizer; and the Division of Plant Protection, Miyun Agricultural Research Institute

TITLE: "The Pathogens of Some Virus Diseases of Cereals in China"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 1, Mar 79 pp 89-95

TEXT OF ENGLISH ABSTRACT:

Byusing the polyethylene glycol precipitation and differential centrifugation methods in succession, a partially purified antigen of wheat rosette stunt disease has been isolated and the corresponding antiserum prepared. The presence of viral antigens in plants and vectors were detected by the modified passive hemagglutination test and capillary tube ring interface precipitation test. Compared with biological assay, the coincidence of the modified passive hemagglutination test for single plant hoppers approached 89%.

| Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79  
pp 89-95 |

Received 11 April 1978

C50: 430%

Biochemistry

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TITLE: "Studies on Immobilized Polynucleotide Phosphorylase II. The Application of Immobilized Enzyme For the Preparation of Poly I and Poly C"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 97-104

TEXT OF ENGLISH ABSTRACT:

The immobilized polynucleotide phosphorylase was used to prepare poly I and poly C. The optimal conditions for batchwise polymerization of IDP were pH 10, 3~6 mM MgCl<sub>2</sub>, and 42°C, while those of CDP were pH 8.9, 6~12 mM MgCl<sub>2</sub>, and 42°C. In order to minimize the hydrolysis of polymer, the preparations were carried out at pH 9 and 37°C.

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 2, Jun 79  
pp 97-104]

The immobilized PNPase column reactor had been used continuously for 1.5~2 months without loss of activity to catalyze the polymerization of IDP or CDP at pH 9, 37°C in the presence of 6 mM MgCl<sub>2</sub> and 0.04% NaNO<sub>3</sub>.

The reaction mixture after polymerization could be separated from immobilized PNPase by simple filtration and was protein-free. The acute animal toxicity test indicated that poly I or poly C synthesized by immobilized enzyme column reactor met safety requirement. Therefore, the tedious step of protein removal with phenol extraction can be omitted and the industrial application of immobilized enzyme reactor may be anticipated.

Thanks are due Pharmaceutical Plant of Beijing University, Tianjin Monosodium Glutamate Plant and Genetic Institute of Chinese Academy of Sciences for conducting toxic experiment and preparation of poly I and poly C. LI Shufang [7812 3219 5364] took part in some work.

Received 1 April 1978.

AUTHOR: XIA Bangying [1115 6721 7336]  
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TITLE: "Physical and Chemical Properties of Ribosomal RNA in Silkgland and Pupal Ovary of Bombyx Mori"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 105-112

TEXT OF ENGLISH ABSTRACT:

This paper describes the biochemical and biophysical properties of rRNA in the silkgland and the pupal ovary of *Bombyx mori*. These RNA samples contain DNA to about 0.4% and protein to about 0.4% and have attained the purity demanded.

The content of organic phosphorus in rRNA of the silkgland is 8.07%. The  $\epsilon(p)$  value in 0.15M NaCl-0.015M sodium citrate is 7350; in 0.1M NaCl, 7149; in H<sub>2</sub>O, 8512. The maximum absorption in 0.1M NaCl is at 260nm; the minimum is at 231nm and the ratio of 260/280 is 1.96. Similarly, the content of organic phosphorus occupies rRNA of pupal ovary for 8.07%, thus  $\epsilon(p)$  of rRNA in 0.15M NaCl-0.015M sodium citrate is 7441; in 0.1M NaCl, 7224 and in H<sub>2</sub>O, 8413.

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 2, Jun 79 pp 105-112]

The rRNA preparation of the silkgland has the following base composition: adenine 26.1%, guanine 29.4%, cytosine 23.7% and uracil 20.7%. Analysis of the base composition of ovarian rRNA indicates that adenine occupies 26.4%, guanine 29.6%, cytosine 23.6% and uracil 20.4%.

The thermo-hyperchromicity of silkgland rRNA is 22.5% and the T<sub>m</sub> value is 43.7°C. The hyperchromicity of ovarian rRNA is 25.4% and the T<sub>m</sub> value is 45°C.

Analysis of silkgland rRNA in 5~10% (W/V) sucrose density gradient centrifugation shows two components, the first one is the large subunit and the second is the small subunit.

Utilizing ultracentrifugation analysis, it shows that the sedimentation coefficients of both silkgland rRNA and ovarian rRNA are the same; the sedimentation coefficient of the larger subunit is 29 and that of the smaller one is 18. From the S values the molecular weights of the subunits of rRNA are calculated. The significance of the results mentioned above is discussed.

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 2, Jun 79  
pp 105-112]

Thanks are due WU Qiuyan [0702 4428 7129] for taking part in preparations, as well as GUO Yaojun [6753 1031 0689] and YANG Zhenfan [2799 2182 5672] of Institute of Biophysics, Chinese Academy of Sciences for conducting analyses.

Received 5 November 1977.

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ORG: All of the Second Laboratory, Shanghai Institute of Biochemistry,  
Chinese Academy of Sciences

TITLE: "The Micromethods for Sequencing Ribonucleic Acids IV. A Micro-Chromophoric Labeling Method for the Determination of 3'-Termini of Oligoribonucleotides"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 113-120

TEXT OF ENGLISH ABSTRACT:

A new colorimetric method has been devised for the determination of 3'-termini of oligoribonucleotides. This method is based on the principle that the terminal ribosyl moieties of oligoribonucleotides are oxidized to the corresponding dialdehydes which react with certain colored hydrazides to produce the terminal labeled oligoribonucleotide hydrazones.

In this report, the methods for the preparation of colored hydrazides, 4-methylaminoazobenzene-4'-sulphonyl glycyl hydrazide(DABS-Gly-NHNH<sub>2</sub>)and 4-dimethylaminoazobenzene-4'-sulphonyl hydrazide (DABS-NHNH<sub>2</sub>) as well as their nucleoside hydrazone are presented.

These hydrazone are hydrolyzed with nucleases and the nucleoside released can be visualized directly on the polyamide thin layer plate after spraying hydrochloric acid.

The sensitivity of this method may be indicated by the fact that as little as  $10^{-9}$   $10^{-10}$  mole of nucleosides can be labeled and detected on the polyamide plate.

Reagent DABS-Gly-NHNH<sub>2</sub> has been employed to label the 3'-termini of four different oligoribonucleotides, the amount of which ranged from 0.08~0.12 A at 260 nm. (about  $10^{-9}$  mole).

The capacity of the two types of hydrazides for labeling the nucleoside dialdehydes is briefly discussed.

Thanks are due ZHI Baozhen [6175 1405 3791] and LI Huiping [0536 1920 5493] for conducting element analysis.

Received 3 March 1978.

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ORG: All of the Xuzhou Medical College

TITLE: "The Chromatography of 3',5'-Cyclic Adenylic Acid (cAMP) and Related Compounds on Alumina Thin-Layer Sheets"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 121-126

TEXT OF ENGLISH ABSTRACT:

With solvent systems of graded polarity on alumina thin layer sheets, the chromatographic behavior of cAMP and its related compounds has been investigated. It was found that the solvent system of butanol, ethyl alcohol, water(30:10:13)gave effective separations of cAMP from adenine, adenosine, 3', 5'-cyclic guanylic acid (cGMP), diadenosine-5'-pyrophosphate and AMP (GMP, GTP, ATP). Quantitative elution of cAMP from spots could be performed with neutral phosphate or citrate

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 2, Jun 79  
pp 121-126]

solution. This technique was successfully employed in the analysis of reaction mixtures of cAMP synthesis, and in the assay of cyclic nucleotide phosphodiesterase.

Received 3 May 1978.

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ORG: LI, WU, LIU of the Institute of Biochemistry, Chinese Academy of Sciences, Shanghai, and WU and XIE of the Shanghai Institute of Technology for Measurement and Weight

TITLE: "Determination of 15 Elements in Blood From the Natural Population"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 127-132

TEXT OF ENGLISH ABSTRACT:

In this communication, the whole blood contents of 15 elements (Na, K, Ca, Mg, Zn, Cu, Pb, Au, Ni, Co, Cr, Cd, Mn and Mo) in samples pooled from 1434 donors are reported. Samples were taken from the natural population scattered in the provinces of Kiangsu, Chekiang and the Shanghai suburban area. Except for the element molybdenum, the analysis of the other elements was carried out with the atomic absorption spectrometer. Potentiometry was used for the determination of Mo.

Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 2, Jun 79  
pp 127-132

According to the contents found, the 15 elements can be divided into 4 groups: 1. No regional or sex difference observed for the following elements: Na, Mg, Mn, Co, Au, Cr and Cd. 2. No regional difference but sex difference noticed for the following elements: Zn and Fe. 3. Regional difference found for the following elements: K, Ca, Cu, Mo and Ni. 4. Both regional and sex difference found for the following element: Pb. The analysis showed that in the region with higher incidence of liver cancer the whole blood contents of Mo and Cu were lower while the content of Pb seemed to be higher. In the same area blood contents of Mo and Cu of the male donors appeared to be lower than those of the female, but the contents of Pb and Zn seemed to be higher. This result ran parallel with the difference in the incidence of liver cancer between both sexes.

Received 3 May 1979.

AUTHOR: LI Wenqin [2621 2429 3830]  
SUN Yukun [1327 3768 2492]

ORG: Both of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences

TITLE: "Study on the Production of 5'-Nucleotides by Autolysis of Geotrichum Candidum Cells"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2 Jun 79 pp 133-138

TEXT OF ENGLISH ABSTRACT:

Fresh *Geotrichum candidum* cells were autolyzed in borax buffer of pH 10, at 33°C for about 20 hours. The endogenous RNA was degraded to form 5'-nucleotides. The yield of total 5'-nucleotides is about 80%.

Received 8 May 1978

AUTHOR: LIU Huitu [2692 1920 0956]  
XUE Shaobai [5641 4801 4101]

ORG: Both of The Department of Biology Beijing Normal University

TITLE: "Cell Cycle Phase of Incorporation of <sup>57</sup>Co-Zhengkaungmycin into CaEs-17 Cell Line Derived From Human Esophageal Carcinoma"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 139-144

TEXT OF ENGLISH ABSTRACT:

ZhengKaungmycin is an antitumor antibiotic screened out in China. Its physical and chemical properties are very similar to those of bleomycin (BLM).

When <sup>57</sup>Co-ZhengKaungmycin ( $A_1 + B_1$  mixture and  $A_6$ ) was incorporated into CaEs-17 cell line derived from human esophageal carcinoma, an autoradiograph showed that <sup>57</sup>Co-ZhengKaungmycin was incorporated into the nucleus, very little into the nucleoli and none at all into the cytoplasm. The results were consistent with the observations that there were specific binding as well as interactions between BLM and DNA, and no binding and no interaction were found between BLM and rRNA,

tRNA and albumin, thus proving the existence of specific binding between Zheng-Kaungmyein and DNA in the localization of intracellular levels.

By applying double labelling autoradiography with both simultaneous incorporation of <sup>14</sup>C-TdR and <sup>67</sup>Co-ZhengKaungmyein and the incorporation of <sup>14</sup>C-TdR followed by <sup>67</sup>Co-ZhengKaungmyein in sequence and by practising the measurement of DNA relative contents of the labelled and unlabelled cells through microspectrophotometry, it was shown that <sup>67</sup>Co-ZhengKaungmyein had been incorporated into CaEs-17 cells which had G<sub>1</sub>/G<sub>0</sub> DNA as their content.

Thanks are due the surgical laboratory, People's Hospital, Beijing Medical College for providing CaEs-17 cells.

Received 10 May 1978.

AUTHOR: None

ORG: Department of Pathophysiology, Shanghai First Medical College

TITLE: "Measurement of Lymphocyte Transformation in Vitro Using Tritiated Thymidine II. Some Basic Factors Affecting Whole Blood Culture and the Incorporation of Isotope"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 145-150

TEXT OF ENGLISH ABSTRACT:

Several factors affecting the lymphocyte transformation and the incorporation of tritiated thymidine in phytohemagglutinin (PHA) stimulated whole blood culture were investigated. The radioisotope assay was performed by the technique of harvesting the cells on  $\frac{1}{4}$  glass fiber paper discs for liquid scintillation count. Optimal results were obtained when  $2 \times 10^6$  lymphocyte were cultured in 2 ml pH 7.6 RPMI 1640 medium with 2  $\mu$ Ci of <sup>3</sup>H-thymidine (5 Ci/mM) added 4 or 16 hours prior to completion

of the 70-hour culture. For most cultures, 40 µg/ml of crude PHA preparation was found to be optimal but a dose-response curve may be indicated as various individuals respond differently to different concentrations of PHA. Fetal calf serum as well as 5% CO<sub>2</sub> in the gaseous phase may, for the whole blood culture, not be necessary and hence could be omitted.

Thanks are due Professor ZHU Yidong [2612 4135 2767], director of faculty research section for his counsel as well as the Central Isotope Laboratory of Shanghai First Medical College for conducting measurements.

Received 18 May 1978.

AUTHOR: LI Xiaoyu [2621 2556 3768]  
LIANG Huizhen [2733 1920 3791]  
LIU Mingzhang [0491 2494 4545]  
ZHANG Zhuying [1728 4554 5391]  
Zhai Shikang [5049 0013 1660]  
WANG Daoyuan [3769 6670 5373]  
SHEN Meiling [3088 5019 3781]  
XU Bin [5171 1755]

ORG: All of the Shanghai Institute of Materia Medica, Chinese Academy of Sciences

TITLE: "Pharmacological Studies of Oxalysine on Experimental Hepatitis"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 151-158

TEXT OF ENGLISH ABSTRACT:

Toxic hepatitis was induced with carbon tetrachloride in mice. L-4-oxalysine (I-677) 100mg/kg injected daily has been proved to be effective in lowering the serum glutamic-pyruvate transaminase (SGPT) level in both acute and subacute liver injuries. Pathological examinations also showed that the degeneration and necrosis of liver cells

were protected by the administration of I-677. In the course of inducing experimental liver cirrhosis with  $\text{CCL}_4$ , I-677 administered for 8 weeks affected neither liver function besides a lowering of serum bilirubin, nor liver collagen content and histological appearance. The mechanism of serum GPT-lowering was found to be a lowering of hepatic enzyme activity. No direct inhibition on the activity of both liver and serum GPT was observed *in vitro*. The transaminase-lowering effect of I-677 could not be antagonized by simultaneous administrations of L-lysine. Amino-oxyacetic acid, a GPT inhibitor, showed potent inhibition on the GPT activity *in vitro*, but not *in vivo*. Large doses of I-677 (8-32 times the clinical dose) for 11 weeks in rats induced a lowering of serum albumin, a decrease of incorporation of  $^3\text{H}$ -lysine into serum protein, and an increase of the lipid of liver. This revealed that albumin synthesis and lipid transport function of liver were inhibited by I-677, but this effect could be antagonized by L-lysine.

Thanks are due Professor DING Guangsheng [0002 0342 3932] and WANG Jingying [3076 7234 5371] for their counsel.

Received 30 May 1978.

AUTHOR: ZHU Shangquan [2612 1424 2938]  
LI Tongfen [2621 2717 5358]  
CAO Qiuping [2580 4428 1627]  
ZHANG Youshang [1728 0645 1424]

ORG: All of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences, Shanghai, China

TITLE: "Studies on the Structure-Function Relations of Insulin IV. The effect of  $\text{B}_{22}$ -Arginine Replacement on the Biological Activity of Insulin"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 159-168]

TEXT OF ENGLISH ABSTRACT:

The semisyntheses of a series of  $\text{B}_{22}$ -D-Ala deshexapeptide insulin analogs with  $\text{B}_{22}$ -arginine replacement were described. The following semisynthetic scheme was used:

OMe  
|  
desmonopeptide insulin pentamethyl ester (DNIOH) was prepared from insulin hexamethyl ester (INS-OMe) through the action of trypsin and carboxypeptidase B, the amino groups were protected with Boc-groups and the protected product was condensed

Boc OTB  
|   |

with X-D-Ala·PheOMe (X = Gly, D-Arg, Val, Arg, Lys, Asp), the protecting groups were removed by trifluoroacetic acid treatment and saponification. The biological activities of these analogs indicate that  $B_{21}$ -Arg is not unchangeable and can be replaced by Lys or even Asp without any influence on the biological activity which is 20% as compared to that of insulin. The activity is reduced to one half when it is replaced by valine or to a very low level when replaced by Gly or D-Arg.

The role of  $B_{21}$ -Arg in the maintenance of insulin conformation and the biological activity and the reason for the low activity of guinea pig insulin were discussed.

Received 12 June 1978

AUTHOR: TU Guangzhou [3205 0342 0321]  
RAN Yonglu [0373 3057 4380]  
WU Tianai [2976 1131 1947]  
YU Li [0060 0500]

ORG: All of the Kunming Institute of Zoology, Chinese Academy of Sciences

TITLE: "Studies on Snake Venoms and Their Utilization IV. Chromatographic Fractionation of the Venom of Agkistrodon halys Pallas (From Chekiang) and the Purification of the Phosphodiesterase on a Large Scale"

SOURCE: Shanghai SHENGWUHUAXUE YU SHE.GWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 169-174

TEXT OF ENGLISH ABSTRACT:

The venom of *Agkistrodon halys* Pallas (from Chekiang) was fractionated on DEAE-Sephadex A-50 into fourteen different fractions. The following enzymatic activities, i.e., Phosphodiesterase, 5'-nucleotidase, proteinase, amino acid esterase, L-amino acid oxidase and phospholipase A, as well as hemorrhagic, anticoagulant and plasmin-like

[Continuation of SHENGWUHUAXUE YU SHENGWUWULI XUEBAO Vol 11, No 1, Mar 79  
pp 169-174]

principles have been determined for each fraction. A simple and economic method of the purification of the phosphodiesterase on a large scale is described. The quality of the product has been characterized and compared with the same product from other countries. Satisfactory results have been achieved in the analysis of the ribose and deoxyribose oligonucleotides by this enzyme.

Taking part in chemical determination were YAN Peifang [0917 0160 5364], WU Renlong [0702 0088 7893], and FENG Yaxiong [7458 0068 7160] of Shanghai Biochemistry Institute, as well as KUANG Daren [0362 6671 0086] of Shanghai Cell Biology Institute of Chinese Academy of Sciences.

Received 19 June 1978.

AUTHOR: HUANG Shikai [7806 0013 2818]  
YE Rong [5509 1369]  
SUNG Xiu'e [1345 4425 1230]  
ZHANG Tiefeng [1728 6993 1496]  
FAN Shifan [5400 0013 5672]

ORG: All of the Shanghai Institute of Physiology, Chinese Academy of Sciences

TITLE: "The Degree of Preservation of the Submicroscopic Structure of Various Tissues of an Ancient Cadaver of Mawantai Tomb No 1 of Han Dynasty"

SOURCE: Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 175-180

TEXT OF ENGLISH ABSTRACT:

The degree of preservation of the submicroscopic structure of skeletal muscle, heart muscle, kidney, chondrocyte and skin of an ancient cadaver of Mawangtai Tomb No.1, Changsha, of the Han Dynasty about 2100 years ago has been examined. The preservation of chondrocyte cells were the best, though in other tissues, the general shape of certain cells were still preserved as well as some subcellular structures such as

[JOURNAL OF SHANGHAI INSTITUTE OF BIOPHYSICS XUEBAO Vol. 11, No. 1, Mar. 79 pp. 175-180]

cytoplasmic membranes, nuclei and some structures which resemble endoplasmic reticulum and mitochondria. Among the intercellular spaces of the above mentioned tissues, there also exist well preserved collagen fibers of distinct band patterns with periodicity between 300 to 600 Å and 7 to 11 striations within each band. In certain parts of the loose connective tissue, these striations can still be recognized, though the results of local extraction experiments show that the properties of the contractile proteins of these parts had already suffered great changes. Besides, numerous spore-like structures believed to be the spore of *Bacillus* were also found in various tissues of the endovar.

Received 20 June 1978.

AUTHOR: ZHENG Qingyu [1982 1987 6965]

ORG: Shanghai Institute of Biochemistry, Chinese Academy of Sciences

TITLE: "A Linear Standard Curve for Radioimmunoassays. The T/B Versus [Ag] Plot"

SOURCE: Shanghai SHENGWUJIAXIE YU SHENGCHUANJI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol. 11, No. 2, Jun. 79 pp. 161-166

#### TEXT OF ENGLISH ABSTRACT

The correlation of various coefficients in radioimmunoassays, which is given in the following equation, is discussed in this paper.

$$\frac{T}{B} = \frac{n}{2} \frac{[{}^3\text{Ag}]_0}{[Ab]_0} + \frac{n}{2} \frac{[Ag]}{[Ab]_0}$$

where

$[{}^3\text{Ag}]_0$  denotes the molar concentration of labelled antigen,  
 $[Ab]_0$  denotes the molar concentration of antibody.

(Ag)<sub>0</sub> denotes the molar concentration of unlabeled antigen,  
 $T$  total cpm, denoting the total radioactivity of (<sup>3</sup>Ag)<sub>0</sub>,  
 $B$  binding cpm, denoting the radioactivity of (<sup>3</sup>Ag-Ab) complex, and  
 $n$  denotes the average number of determinants on one antigen molecule which  
actually take part in the immunoneutralization reaction. At a given (<sup>3</sup>Ag)<sub>0</sub> and  
[Ab]<sub>0</sub>, it might be related to [Ag]<sub>0</sub>, the equilibrium constant, molecular shape  
and structure modifications and the number of Ag-determinant as well.

It follows that: 1.  $T/B$  is linearly related to [Ag]<sub>0</sub>,

2.  $= [Ag]_0 = [^3Ag]_0$  when  $T/B$  is zero,

3.  $T/B$  will be  $\frac{n[{}^3Ag]_0}{2[Ab]_0}$  when [Ag]<sub>0</sub> is zero,

4. the slope of the straight line is  $-\frac{n}{2[Ab]_0}$ .

Thanks are due PAN Jiaxiu (3382 1362 4423), DAO Huangpei (6670 7806 1014),  
WU Shizhen (3170 0013 4176) and ZHOU Chourong (2612 3983 5534) for their  
counsel.

AUTHORS: PENG Jiemei [1706 0302 2606]  
CHEN Zuoyi [7115 0155 3030]  
SHEN Juying [3088 5468 5391]  
ZHU Fucheng [7612 6395 2032]  
JIN Hingchang [7246 2494 6965]

ORG.: PENG, CHEN, SHEN of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences, ZHU of the Division of Plant Protection, Gansu Institute of Agriculture, and JIN of the Agricultural Research Station, Dunhuang.

TITLE: "Nature of the Pathogen of Maize Streak Dwarf Disease of Tuanhuang, Gansu Province"

SOURCE: Shanghai SHENGWUJIAXUE YU SHENGWUMULI XUEBAO (ACTA BIOCHIMICA ET BIOPHYSICA SINICA) in Chinese Vol 11, No 2, Jun 79 pp 187-189

TEXT OF ENGLISH ABSTRACT:

The maize streak dwarf disease which caused a lot of damage to the maize crop in Tuanhuang, Gansu province, was transmitted by the plant hopper *Laddelphus striatellus* Fallén. In the ultra-thin sections and in the extracts of the leaf cells of the diseased

[Continuation of SHENGWUJIAXUE YU SHENGWUMULI XUEBAO Vol 11, No 1, Mar 79 pp 187-189]

but not healthy plants a new rhabdo virus measuring 43~64×150~220 nm (in sections) or 70~80×200~250 nm (in extracts) was detected. The virus particles were seen to be enwrapped both between the inner and outer nuclear membrane and in the endoplasmic reticula.

Thanks are due CAO Tianqin [2580 1131 2953] for his counsel, as well as Dunhuang County Agricultural Research Station and Jiuquan Prefecture Agricultural Bureau for providing assistances. TAO Shizhen [7118 0013 3791] took part in some work.

Received 10 October 1978.

Authors: CHEN Zuyi (1119 0155 5030)  
HEI Juying (2008 5468 5301)  
TAO Shizhen (1118 0013 3791)  
GONG Zengwu (1895 4371 1053)  
CHEN Ruiqiong (1119 0035 2817)  
DAI Yunding (2071 2588 2494)

OBJ: CHEN Zuyi, HEI, TAO and GONG of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences, CHEN Ruiqiong and DAI of the South China Institute of Tropical Crops, Hainan

TITLE: "Studies on the Pathogens of Huanglongbing (Citrus Yellow Shoot Disease) III. Mycoplasma-like Organisms Association With Huanglongbing in Guangdong"

SOURCE: Shanghai SHENGWUJIAXUE YU SHENGWUWU XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 11, No 2, Jun 79 pp 191-192

TEXT OF ENGLISH ABSTRACT:

The spring, summer and autumn shoots of citrus were collected from the Puting district, Kwangtung province and from the Yang-Tsun Overseas Chinese Citrus Orchard in March-September, 1978. Electron microscope examinations of the phloem tissues of

[Continuation of SHENGWUJIAXUE YU SHENGWUWU XUEBAO Vol 11, No 1, Mar 79 pp 191-192]

leaf vein revealed the presence in cells of pleomorphic mycoplasma-like organisms (MLO) from 60~70 nm, with a bilamina unit membrane of thickness 20 nm and nuclear strands inside the organism. The MLO were found to damage the sieve tube cell and cause necrosis. In addition to MLO we have also demonstrated the existence of filamentous virus particles.

Marked remission of symptoms could be elicited by injecting tetracycline hydrochloride into the diseased tree.

Thanks are due CAO Tianqin [2580 1131 2953] and PENG Jianmu [1756 0502 2606] for their counsel, as well as HUANG Yongwen [1806 3057 2429] and LAI Jiaping [6311 1696 1627] of Puting County Fruit Tree Station, Guangdong Province for providing supports.

Received 11 October 1978.

## Electronics

AUTHOR: BAO Ximao [7637 1385 5399]  
ZHENG Xiangqin [6774 4382 2953]  
LIU Chengen [2692 2110 1869]  
JI Fuguan [1518 4395 2938]

ORG: None

TITLE: "Design and Performance of ECL Two-Bit Adder"

SOURCE: Beijing DIANZI XUEBAO (ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS) in Chinese No 2 Jun 79 pp 1-7

### TEXT OF ENGLISH ABSTRACT:

In this paper some improvements of ECL full adder have been presented. They simplify the structure and reduce the clock pulse number to three. Two of them are the same as those of the ordinary two phase CED. This is of great significance for combining CED memory with ECL to develop a microprocessor signal processing system. A 3-word 8-bit adder has been fabricated using conventional MOS technology. Design considerations and experimental results are also given.

Received December 1978.

AUTHOR: OUYANG Jingzhen [2962 7122 2529 2973]

ORG: None

TITLE: "Correlator Without Multiplier"

SOURCE: Beijing DIANZI XUEBAO (ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS) in Chinese No 2 Jun 79 pp 8-22

### TEXT OF ENGLISH ABSTRACT:

Errors of "single channel quantized" correlators are analyzed. The total error due to finite discrimination and bias is dependent on the limited level of the quantized input signal. It is pointed out that there is an optimum limited level range within which the total error should be minimized and the minimum error is almost independent of the quantized number. However, the optimum limited level range is dependent on the quantized number. Taking advantage of the analysis of the bias, an enhanced correlator without multiplier is deduced for Gaussian process and sinusoidal wave with random phase. According to the error analysis of this correlator, it is concluded that the correlator without multiplier is rather simple and accurate and therefore is especially suitable for high frequency measurements.

Received October 1978.

AUTHOR: CHEN Jingchun [7313 2617 3174]

ORG: None

TITLE: "On 'Blind Spots' of the Phased Array"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] JOURNAL OF ELECTRONICS] in Chinese No 7 Jun 79 pp 23-36

TEXT OF ENGLISH ABSTRACT:

"Blind spot" is a well known phenomena occurring in the operation of the phased array. Blind spot means total reflection of input power. Failure of two conditions leads to total reflection, null of the conversion resistance or infinity of the admittance. This paper is to investigate these conditions. Through detail mathematical analysis, it is concluded that the null of the resistance is the only reason to cause total reflection i.e. "blind spot". Besides, approximate conditions for existence of the null of the radiation resistance are given. We have also obtained some results different from those published in foreign literature.

MAO Jun [1120 6816] and PANG Ronghang [2435 5176 5100] revised the draft and provided counsel.

Received June 1979.

AUTHOR: HU Jinchun [0470 6930 7311]

ORG: None

TITLE: "A New Concept of Waveguide Characteristic Impedance"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] JOURNAL OF ELECTRONICS] in Chinese No 2 Jun 79 pp 37-46

TEXT OF ENGLISH ABSTRACT:

The paper deals with the concept of waveguide characteristic impedance. It tries to prove that the conventional concept of rectangular waveguide characteristic impedance is not fully applicable. The author presents new analysis of the principle and method used to define waveguide characteristic impedance and gives a reasonable definition of rectangular waveguide characteristic impedance. The new concept is applied to long range circular waveguide. The author also presents in this paper his own measuring tolerance of the waveguide of rectangular waveguide.

GUAN Yuxian [6079 1381 2775], LI Lushan [2621 2867 1472], WANG Yougong [3769 7589 5367], LI Bi [2621 5396] and LI Shouyuan [2651 1343 6678] provided counsel.

Received May 1979.

AUTHOR: XU Yanzheng [ 776 3401 3932 ]

ORG: None

TITLE: "Theoretical Analysis on Microwave Ferrite Microstrip Isolators"

SOURCE: Beijing DIANZI XUEBAO (ACTA ELECTRONICA SINICA) JOURNAL OF ELECTRONICS] in Chinese No 2 Jun 79 pp 45-49

TEXT OF ENGLISH ABSTRACT:

**Abstract.** In this article, solutions to characterize equations of microwave ferrite microstrip isolators with one edge grounded have been given. Theoretical results have proved that the isolator is of cut-off type, and that it can be applied to other microwave ferrite devices.

Received August 1978.

AUTHOR: HANG Chengren [ 2635 2110 0088 ]  
CHEN Wanfang [ 7115 5302 2455 ]

ORG: None

TITLE: "A Piecewise Interpolation Method of Connecting Discrete Points into Smooth Curves"

SOURCE: Beijing DIANZI XUEBAO (ACTA ELECTRONICA SINICA) JOURNAL OF ELECTRONICS] in Chinese No 2 Jun 79 pp 50-60

TEXT OF ENGLISH ABSTRACT:

**Abstract.** In computer-aided design graphic processing and other areas, a variety of methods are widely used to obtain smooth curves by connecting discrete points. But the traditional methods have many limitations over distribution of given points, whereby the curves so produced are often not satisfactory enough and even incomplete. The verified method presented here is simple in calculation and of no limit over distribution of given points. Moreover, approximately ideal results are obtained for the cases that other methods do not provide complete calculating.

Received September 1978.

AUTHOR: LI Yuelmen [2621 6676 2629]  
WANG Beijin [3760 1795 7163]  
WU Lin [0606 7207]  
QIN Xuying [4460 6423 5391]

ORG: None

TITLE: "Low Loss Simulated Inductor"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS]  
In Chinese No 2 Jun 79 pp 61-67

#### TEXT OF ENGLISH ABSTRACT:

**Abstract.** This paper presents a simple low loss simulated inductor using only two transistors and a few passive elements. In realization of simulated inductors, the alignment is easily effected by only varying the value of one of the resistors or the capacitor to get the correct inductive value. Moreover, the value of Q can be compensated to designed value. Theoretical analysis and experiments are well matched. Using this simulated inductor, high pass filter is constructed with good performance. Thus, it is proved suitable for engineering application.

Received September 1978.

AUTHOR: FAN Dexen [2868 1795 2773]  
CHEN Kun [7115 6924]

ORG: None

TITLE: "Computer Analysis of Microwave Circuits--A General Purpose Analysis Program of Treelike Microwave Circuits MCAP I"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS]  
In Chinese No 2, Jun 79 pp 68-76

#### TEXT OF ENGLISH ABSTRACT:

**Abstract.** One of the computer analysis methods of microwave circuits is presented and a general purpose analysis program named MCAP I for treelike microwave circuits is described. The program will automatically analyse the frequency response of the circuit having topologies and elements which are given by the user. The mathematical model and the essential parts of the program are explained.

Received March 1978.

AUTHOR: YANG Datong [2799 1129 0681]  
CHEN Wenxiang [7115 2429 7160]  
YAN Jiwen [2518 6949 2429]  
LIU Zhixiong [0491 1807 7160]  
XINHE Jiye [6007 7024 4764 2814]

ORG: None

TITLE: "Calculations and Experiments on the Post-Deflection Acceleration Lens With Spherical Mesh Grid in Oscilloscope Tube"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 2, Jun 79 pp 77-85

TEXT OF ENGLISH ABSTRACT:

**Abstract.** The post-deflection acceleration lens with spherical mesh grid in oscilloscope tubes are calculated with the aid of a digital computer. The paraxial behaviour of the post-deflection acceleration lens of different geometries, such as the position of the focal point, the focal length and the axial magnification, are given by numerical calculations. Several experimental tubes have been measured and the theoretical analyses are given. The results are useful for design of CRT.

[Continuation of DIANZI XUEBAO No 2, Jun 79 pp 77-85]

ZHAO Xingyu [6392 5281 6877], FU Yuan [0263 3293] and LIU Libin [0491 0500 3453] took part in experiments.

Received May 1978.

AUTHORS: LIN Weigang [2031 3634 1026]  
PAN Weiyan [3382 1218 3506]

ORG1: None

TITLE: "Determination of the Characteristic Impedance of a Coaxial System Consisting of a Rectangular Cylinder Concentric With an External Circular Cylinder"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 2, Jun 79 pp 86-90

TEXT OF ENGLISH ABSTRACT:

**Abstract.** The coaxial system consisting of a rectangular cylinder concentric with an external circular cylinder is conformally mapped into a unit circle concentric with a closed curve which is nearly a circle. The characteristic impedances of this latter coaxial system are determined, and plotted for reference.

Received April 1978.

AUTHORS: MA Yutong [7456 0151 4547]

ORG1: None

TITLE: "A Research Into the Modulated-Wave Parametric Amplifier"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 2, Jun 79 pp 91-93

TEXT OF ENGLISH ABSTRACT:

**Abstract.** This article presents a new idea of applying the principle of parametric amplification to the high power AM transmitter; illustrates the advantage of amplifying modulated wave by means of one linear resistance; briefly discusses the high power varactor and a design for the electric circuit; and, by way of suggestion, makes up a particular draft.

Received April 1978.

AUTHORS: ZOU Shichang [6700 0013 2490]  
B. I. Deutch  
LIN Xianghual [2692 5980 2037]  
ZHOU Zuyao [0719 6371 1031]  
HU Jiazeng [5170 0502 1073]  
DAI Benzhi [2071 0088 0037]  
ZHU Deshang [2612 1795 1757]  
CAO Dexin [2580 1795 2450]

ORG: Deutch of the Institute of Physics, University of Aarhus, Denmark.

TITLE: "Studies on Pulsed Laser Annealing of Si Implanted With Bi"

SOURCE: Beijing DIANZI XUEBAO (ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS) in Chinese No 2, Jun 79 pp 94-97

TEXT OF ENGLISH ABSTRACT:

Abstract. Channel backscattering technique has been used to investigate pulsed laser and thermal annealing of (111)Si single crystals heavily implanted with Bi. Up to 800°C, thermal annealing residual damage amounts to 15% but at 700°C, the ratio of substitution of Bi atoms maximum to 10%. It drops down with the rise of temperature. Diffusion of Bi atoms even when the annealing temperature exceeds 800°C. However, after pulsed laser annealing, lattice damage almost completely disappeared and Bi

(Continuation of DIANZI XUEBAO No 2, Jun 79 pp 97-97)

atoms are redistributed. The concentration of Bi in Si may exceed its solid solubility by an order of magnitude. 95% of Bi atoms are in substitutional sites. Annealing at different energy has been compared too.

The Isotope Separator Laboratory, Institute of Physics, University of Aarhus, conducted ion implantation. The Shanghai Metallurgy Institute and Shanghai Optics and Precision Instruments Institute of Chinese Academy of Sciences took part in the work.

Received February 1979.

AUTHORS: PU Shulan [0269 3219 3358]  
CUIN Jianwen [7115 1696 2629]  
LIU Hanchong [0691 1181 1347]

ORG: None

TITLE: "Relation between XeF Induction Radiation Spectrum and Laser Radiation Conditions"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 2, Jun 79 pp 98-100

TEXT OF ENGLISH ABSTRACT:

Abstract. Since Dicke's radiometer came into being, the total power radiometer has almost been eliminated from the high sensitivity radiometers. By means of further analysis, comparison and test, the paper shows that the gas stability of the total power radiometer can be greatly improved with the development of the electronic technology, and its sensitivity greatly enhanced. It is as good as Dicke's radiometer.

This paper introduces the design of the In-band total power radiometer which can be used for calibration of the noise source, and design of its IF amplifier. Recording curves of the stability and sensitivity of the radiometer are also given.

Received January 1979.

AUTHORS: XIAO Changde [9618 7022 1795]

ORG: None

TITLE: "On Sensitivity of the Total Power Radiometer"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 2, Jun 79 pp 101-106

TEXT OF ENGLISH ABSTRACT:

Abstract. The experiment described in this paper have proved that XeF laser spectrum has a structure of rich vibration rotation. Laser spectrum are dependent upon laser radiation conditions. Low pressure and high feedback is favorable for laser radiation of short wavelength from higher vibration state. In the experiment 162 laser lines have been observed, in which a set of laser lines of 347 nm is of shortest wavelength of XeF Laser.

Received October 1978.

AUTHOR: HUANG HONGJIA [7806 1347 0857]

ORG: None

TITLE: "From Microwaves to Optics"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS]  
in Chinese No 3, Sep 79 pp 1-22

TEXT OF ENGLISH ABSTRACT:

Abstract. The meaning of the title of this review is two-fold; on the one hand, it reflects the general trend towards higher and higher frequencies in the development of modern electronics, particularly the effort made in spanning the microwave infrared gap, and on the other hand, it implies the union of microwaves and optics, which yields Microwave Optics as an interdisciplinary field of study. The paper includes the following sub-titles;

1. The early union of microwaves and optics, and its later development; (1) The initial thought of microwave optics; (2) The development of microwave optics.

2. Spanning the spectrum from microwaves to optics; (1) The microwaveinfrared gap; (2) The breakthrough of gyrotron and the outgrowth of high-energy or relativistic electronics.

[Continuation of DIANZI XUEBAO No 3, Sep 79 pp 1-22]

3. Microwave optics and the modern optical fiber theories; (1) Modal theory vs ray theory; (2) Single-mode and multimode fibers; (3) Mode coupling; (4) Measurable quantities; (5) Quantum theory and formal quantum theory.

The author endeavours to describe the evolution of the physical ideas relevant to the variety of problems discussed, and presents some points of view hitherto not explicitly expressed, or not sufficiently emphasized, in the literature.

AUTHOR: ZHOU Ninghua [0719 3942 5478]

ORG: Note

TITLE: "An Analysis and Practice of Low Drift Operational Module"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] In Chinese No 3, Sep 79 pp 23-34

#### TEXT OF ENGLISH ABSTRACT:

**Abstract.** This article attempts to propose theoretical computing formulas for input offset voltage and common mode rejection ratio of common emitter differential amplifier, common emitter-common base differential cascode amplifier and common emitter-common grid differential cascode amplifier. It proves that Early effect plays an important role so far as input offset and common mode rejection characteristics are concerned.

In the past analysis on differential amplifiers offset characteristic and common mode rejection characteristic have been separately dealt with as two different questions. And, in discussing offset characteristic the existence of Early effect, the essence of the matter has been neglected. However, if Early effect is analyzed as the leading factor, input offset characteristic and common mode characteristic of differential amplifier will fundamentally be unified in one. Such an analysis will clearly show how differential amplifier circuits have been developed.

[Continuation of DIANZI XUEBAO No 3, Sep 79 pp 23-34]

The results thus obtained have led to the design of low drift operational models. The article analyzes the drift contribution to the input offset voltage from the nonideal characteristic of the following stage and gives the method to match low drift.

In this operational module, open loop gain and common mode rejection ratio are no less than 10000 and offset voltage drift is no more than  $\pm 0.5 \mu\text{V}/^\circ\text{C}$ . Hence, it can be used as high quality general purpose operational devices for automatic control and automatic detecting system.

Received October 1978.

AUTHOR: WANG Shouguo [3769 1343 2976]  
WU Ronghan [0702 2837 3352]  
ZHU Qigao [2612 0366 7559]  
ZHANG Quansheng [1726 2938 3932]  
LI Zhaoyin [2621 3564 6892]  
TIAN Buliang [3944 1979 5328]

ORG: None

TITLE: "A GaAs/GaAlAs PNP Negative-Resistance Laser With Low Threshold Current"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 3, Sep 79 pp 35-43

TEXT OF ENGLISH ABSTRACT: A PNP type negative-resistance laser has been obtained with the following heterojunction structure.

$n^+ \text{GaAs}/n^+ \text{Ga}_{1-x} \text{Al}_x \text{As}/p^+ \text{GaAs}/p^+ \text{Ga}_{1-y} \text{Al}_y \text{As}/p^+ \text{GaAs}/n^+ \text{GaAs}/p^+ \text{Ga}_{1-z} \text{Al}_z \text{As}$   
where  $x = 0.2 \sim 0.3$ ,  $y \leq 0.20$ ,  $z \leq 0.10$ . The operation mechanism and the process technology of this type of devices are discussed. The condition for "on" turning is analyzed and some electrical parameters and stimulated emission

(Continuation of DIANZI XUEBAO No 3, Sep 79 pp 35-43)

characteristics of the devices are measured. These devices have a turn-on voltage of about 12~20 V, and the stand-on current is about 10~100 mA, while the corresponding stand-on voltage is about 1.5V. The lowest threshold current density is about  $2500 \text{ A/cm}^2$ . Stimulated emission by self-oscillations may easily be realized when the device is connected in a simple relaxation circuit.

The staff of Seventh Laboratory of Semiconductor Institute provided assistance.

Received December 1978.

AUTHOR: WEN Junding [3306 0193 7844]

ORG: None

TITLE: "Experimental Studies of Latching Ferrite Phase Shifters of Back-Ridged Waveguide"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 3, Sep 79 pp 46-51

TEXT OF ENGLISH ABSTRACT:

**Abstract.** By concise mathematical explanations and experimental results, a new structure of latching ferrite rectangular waveguide phase shifter is first introduced in this paper. Theoretical results have been proved to be basically identical with experiments. It can be applied to several types of latching ferrite rectangular waveguide phase shifters, such as dielectric loaded, orthogonal two-ridged and two-terminal phase shifter. In particular, it is most suitable for high average power.

Colleague JIANG Renpei [5592 0088 1014] provided counsel.

Received March 1978.

AUTHOR: ZHOU Hianwen [0710 3759 2429]

ORG: Pulse Compression Filter Group, Institute of Acoustical Research, Chinese Academy of Sciences

TITLE: "Studies on Doubt Dispersive Saw Pulse Compression Filter"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 3, Sep 79 pp 52-62

TEXT OF ENGLISH ABSTRACT:

**Abstract.** Based on the fact that superimposed region of ultrasonic pulses by transmitting IDT and by receiving IDT is variable with time, a new theoretical method has been found to analyze double dispersive SAW devices. Using this simple and exact method, the effects of weighting manner, taper length and cutting digit on device performances have been both theoretically and experimentally investigated. Two types of compression filters with center frequency of 60MHz, bandwidth of 10MHz and time delay of 10ns to 100ns have been reported.

Received November 1978.

AUTHOR: SUN Fuchuan [1927 1788 1557]  
DAI Shuping [2071 2885 1627]  
ZHAO Xinzhen [6392 0207 3791]  
QIN Yichun [6640 6095 4783]

ORG: None

TITLE: "An Infrared Instrument Television for Measurement of Dynamic Pupil Area"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 3, Sep 79 pp 63-67

TEXT OF ENGLISH ABSTRACT:

**Abstract.** The control of the changing of pupil area with light intensity has been considered as an automatic process. An infrared instrument television has been designed for the remote measurement of the dynamic pupil area. The experimental results show that the present design is successful. This instrument provides a means to study the pupillary area control system from the point of view of biocybernetics and would be helpful to clinical diagnosis.

Received September 1978.

AUTHOR: CHEN Jie [7115 2212]  
LIN Kexiang [2651 0668 4382]

ORG: None

TITLE: "Autocorrelation Functions and Power Spectrums of PN Code-Digitally-Modulated N-Times Clock Codes"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 3, Sep 79 pp 68-76

TEXT OF ENGLISH ABSTRACT:

**Abstract.** By following the equivalent linear system model<sup>(1)</sup>, general expressions of autocorrelation functions and power spectrums of complex codes have been derived. The complex codes are formed by N-times clock codes which are digitally modulated by PN codes. This method is applicable both to odd and even multiple numbers of clock code frequency. By way of illustrating the method, a particular kind of complex codes is given.

Professors CHEN Zongzhi [7115 1350 7492] and CHEN Fangyun [7115 5364 0336] revised the draft.

Received July 1978.

AUTHOR: YANG QIJI [2799 2757 4014]

ORG: None

TITLE: "Theoretical Calculation of the Characteristic Impedances of the Coaxial Branched Strip Lines"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 3, Sep 79 pp 78-86

TEXT OF ENGLISH ABSTRACT: The mathematical derivation of the formulae used for calculation of the characteristic impedances of the coaxial branched strip lines are given. The characteristic impedances of vertical, symmetrical, flat coupled strip lines are also given.

ZHANG Xiantian [1728 2009 0368], ZHANG Zouchang [1728 4373 2490] and LI Tao [2621 2711] provided support.

Received May 1978.

AUTHOR: LU Mingru [4151 2494 0320]  
JIA Cunxi [6328 1317 0823]

ORG: None

TITLE: "Unequal Spaced Arrays"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 3, Sep 79 pp 87-94

TEXT OF ENGLISH ABSTRACT: To deal with the problems in unequal spaced arrays, a new mathematical procedure has been illustrated. A mathematical expression has been formulated for linear arrays, by summarizing the expressions by S. A. Schelkunoff and setting the array synthesis to zero. Several types of unequal spaced arrays have been described.

Received August 1978.

AUTHOR: LI Ningfu [2621 0682 1788]

ORG: None

TITLE: "Non-Ideal Operational Amplifier"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 4, Dec 79 pp 1-14

TEXT OF ENGLISH ABSTRACT:

**Abstract.** D.C. and A.C. characteristics of non-ideal operational amplifiers are examined from a general viewpoint, and a set of useful expressions and conclusions results are obtained. The suggested linear approximation model takes into consideration the effects of CMRR in a more reasonable manner in comparison with the commonly-used models. The constraints on the linear approximation of OP's in A.C. case are discussed. Besides the slew rate limit  $\frac{dV}{dt}|_{max}$ , or the full power bandwidth  $\omega_p$ , there may be other restrictions such as  $\frac{dV}{dt}|_1$ ,  $\frac{dV}{dt}|_2$ , etc. In some cases, the frequency response of CMRR may influences the transfer characteristics of closed loop OP's. The useful range over which the previous expressions are valid were given. Finally, the suppression of supply noise, the measurements of high frequency gain and other problems are analysed.

Received February 1979.

AUTHOR: LIU Zemin [0491 3419 3046]

ORG: None

TITLE: "Realization Theory for Dissipative Reactance Two-Port Networks"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 4, Dec 79 pp 15-30

TEXT OF ENGLISH ABSTRACT:

**Abstract.** The realization of dissipative reactance two-port networks is proceeded by combining network system of  $Z_dZ_dZ_cT$  and concept of predistortion of ideal two-port networks. This has presented a clearer physical understanding and has led to more significant results. In addition, new ideas and methods have been suggested in the formulation of the transfer function and in the solution of open-circuit impedance parameters. With simple termination impedances at two-ports, formulae have been obtained for the calculation of parameters of open-circuit impedances.

CAI Jintao [5591 6855 3447], LIU Yilun [0491 1355 0243] and WANG Dejun [3769 1795 7165] revised the draft and provided counsel.

Received September 1978.

AUTHOR: TAN Feng [1011 7651]

CITE: None

TITLE: "QCL Resonance In Coupled Waveguides"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 6, Dec 79 pp 31-42

TEXT OF ENGLISH ABSTRACT

**Abstract.** The author has reported the results in reference 1), where the effect of transverse components in the magnetic field of the wave was not taken into consideration to simplify the problem. Based on the modified wave boundary conditions, different coupled wave equations have been obtained for the two coupled waves. At non-resonance points, four-order approximate solutions are in agreement with the results of those in ref. (1). However, at the die-resonance points, theoretical analysis and experiments have confirmed that strong coupling would occur in the QCL coupled system, owing to the resonance. By the use of such phenomena, it is possible to design microwave devices with very short lengths.

Associate Professor TIAN Jingren [6929 2329 0068] provided data in design and experiments.

Received May 1978.

AUTHOR: REN Xing [1327 2650]

CITE: None

TITLE: "A Dry Method to Produce Coated Powder Nickel Cathodes"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 6, Dec 79 pp 43-48

TEXT OF ENGLISH ABSTRACT

**Abstract.** By the use of  $(C_6H_5N_2)_2Ni$  as original material and hydrogenation technique, coated powder nickel cathodes has been obtained as a kind of electron emission material. This simple method has led to stable and large production of CPC powder without causing any harm or pollution. Experimental results have been presented.

HAN Qifang [7281 0166 5164], HE Meiyang [0149 2734 5391], LIAO Xianheng [1675 7350 1854], YANG Shoumin [2799 1343 2404] and WANG Yulin [3769 3768 2651] assisted in experiment and research.

Received December 1978.

AUTHOR: XU Yansheng [1776 3601 3932]

ORG: None

TITLE: "Miniatrized Microwave Ferrite Latching Polarizers"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 4, Dec 79 pp 49-56

TEXT OF ENGLISH ABSTRACT: New constructions of microwave ferrite latching polarizers with both internal and external return paths are suggested. The switching time of the former is a few microseconds, and that of the latter is tens of microseconds. Detailed theoretical analysis and calculations have been made and methods for improving the performance (broadband and high-power operation, etc) of these polarizers have been conceived. It has been shown that the experimental results are in good agreement with the theoretical analysis.

JIANG Zhengchang [3068 2973 2490] assisted in experiment and QIU Qijun [8002 0366 0193] computed data on an electronic computer.

Received March 1979.

AUTHOR: SU Zefeng [5685 3419 1496]

ORG: None

TITLE: "Power Spectrum Analysis of PN Combined Code Digital Modulation Waveforms"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS] in Chinese No 4, Dec 79 pp 57-65

TEXT OF ENGLISH ABSTRACT: By assuming engineering approximation and using theorem (1) for orthogonal expansion of  $D(F \oplus CL)$ , which is the D-transform of  $F \oplus CL$ , general expressions of normalized autocorrelation function and normalized power spectral density function of  $F \oplus CL$  have been derived, where  $F \oplus CL$  is the digital modulation of the combined code by a square wave with a frequency  $M$  times that of the clock frequency. Engineering design examples have also been given.

Received April 1978.

AUTHOR: ZHANG Aichen [1728 1947 3791]

ORG: Note

TITLE: "The Surface Mechanism of Silicon Diffused From the Boron Nitride Planar Source"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS in Chinese No 4, Dec 79 pp 66-73]

TEXT OF ENGLISH ABSTRACT:

**Abstract.** The surface structure and mass transport of silicon diffused from the boron nitride planar source were examined by means of transmission infrared spectroscopy, scanning electron microscope, ellipsometer and four probe measurements, etc. It was found experimentally that the prediffused silicon surface was composed of unreactive deposited  $\text{HBO}_2$  layer—boron silicon glass layer—Si-B phase layer. This surface system, especially the structure and properties of the Si-B phase, changes with diffusion conditions. For the mechanism of the surface process, an analysis based on the general principles of boron doping was given. The conclusion was that the formation of different surface systems result from diffusion control surface reaction. By means of this, phenomena observed in various experiments can be explained.

(Continuation of DIANZI XUEBAO No 4, Dec 79 pp 66-73)

JIAO Pengfei [3542 7720 7378] of Department of Physics, Beijing University, measured infrared spectrum. GE Yuru [5514 3768 1172] and ZHENG Guoxian [6774 0948 2009] assisted in electron microphotography.

Received October 1978.

AUTHOR: LU Baowei [0712 0202 4850]

ORG: Electronics Institute, Chinese Academy of Sciences

TITLE: "A Proposal Regarding the Electromagnetic Unit System"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS in Chinese No 4, Dec 79 pp 74-76

TEXT OF ENGLISH ABSTRACT:

**Abstract.** We propose to introduce two new electromagnetic unit systems, in place of the Gauss unit system, to be used in conjunction with the rationalized MKS unit system. They are both CGS systems called CGSE system and CGSM system respectively, and therefore they are both as convenient for dealing with theoretical problems as the Gauss system, and yet, when expressed in them, the Maxwell equations, etc., take on the same form as when the rationalized MKS system is used, if suitable values for  $\epsilon_0$  and  $\mu_0$  are adopted. This is indeed quite an advantage. Derivations are given to clarify the points.

Received July 1979.

AUTHOR: GU Weijun [7397 1983 0689]

ORG: None

TITLE: "The Discussion of the Linearity of the Dual Ramp A-D Converters"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS in Chinese No 4, Dec 79 pp 77-80

TEXT OF ENGLISH ABSTRACT: This paper discusses the linearity of the dual ramp A-D converters. A formula of linearity is obtained, which differs from the conclusion given by D. Wheable.

Received November 1978.

AUTHOR: ZOU Shichang [6760 0013 2490]  
B. I. Deutch  
LIU Xianghuai [2692 5980 2037]  
CHEN Chaorong [7115 2600 2837]  
LIN Chenglu [2651 2052 7627]  
WU Hengxian [0702 1854 7359]  
LU Shizhen [7120 0013 2823]  
SHEN Zhendong [3088 2182 2639]

ORG: Deutch of the Institute of Physics, University of Aarhus, Denmark

TITLE: "CW Nd-YAG Laser Annealing of Ion Implanted Silicon"

SOURCE: Beijing DIANZI XUEBAO (ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS in Chinese No 4, Dec 79 pp 81-85

TEXT OF ENGLISH ABSTRACT:

Abstract. CW Nd-YAG laser was used to investigate annealing behavior of (100) Si implanted with Bi ions. The backscattering and channeling measurements indicated that CW Nd-YAG laser annealing is a sort of nonmelting solid phase epitaxial regrowth process, which optimizes complete recovery of lattice damage and high substitutability of Bi atoms without impurity redistribution. The experimental results were compared with pulsed Q-switched laser annealing, which induced surface layer melting and impurity redistribution.

[Continuation of DIANZI XUEBAO No 4, Dec 79 pp 81-85]

The Isotope Separator Laboratory, Institute of Physics, University of Aarhus, conducted ion implantation. The Shanghai Institute of Nucleonicks, Chinese Academy of Sciences, as well as Shanghai Metallurgy Institute assisted in testing.

Received July 1979.

AUTHOR: Ye Pengsheng [5509 5338 3932]

ORG: None

TITLE: "A Source-Emitter Coupled Trigger"

SOURCE: Beijing DIANZI XUEBAO (ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS in Chinese No 4, Dec 79 pp 86-91

TEXT OF ENGLISH ABSTRACT:

**Abstract:** The source-emitter coupled trigger, which consists of a FET and a bipolar transistor, possesses extremely small triggering current( $\leq 1\mu A$ ). In this paper, an analysis of the circuit was made, a theoretical formula was given to determine the triggering level, and the possibility of achieving triggering level with zero temperature coefficient was confirmed. It was found that the trigger would exhibit a memory property for  $I_{DS} > U_2/R_2$ ,  $(1 - (U_2/(U_1)))^2$ . This feature makes it possible to design a non-reversible triggering circuit.

The theoretical analysis agrees with experimental results.

Received April 1978.

AUTHOR: ZENG Lingru [2582 0109 0320]

ORG: None

TITLE: "A Quick and Accurate Design Method of Coupled Microstrip Lines"

SOURCE: Beijing DIANZI XUEBAO (ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS in Chinese No 4, Dec 79 pp 92-98

TEXT OF ENGLISH ABSTRACT:

**Abstract:** The design data for coupled microstrip lines on any dielectric substrate material can be determined directly and accurately from those for microstrip lines with known dielectric substrate material with the design data of a single microstrip line being used in an intermediate design stage. The results obtained were presented in the form of simple formulas and compared with computer calculated results.

This method can also be used directly to determine the design dimensions from odd and even mode impedances.

LIN Weigan [2651 3634 1626] and QIAO Shiqiong [0829 4258 3890] provided counsel. ZHANG Zhengqing [1728 2973 0615] and LIU Shuzhang [0491 6615 4545] made computations.

Received July 1978.

AUTHOR: ZHANG Guanghua [1728 0342 5478]  
LIN Bingchun [2651 3521 2504]  
LI Jinrong [2621 6855 2837]

ORIG: None

TITLE: "Ion Implanted Bipolar ECL Silicon IC"

SOURCE: Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA; JOURNAL OF ELECTRONICS  
in Chinese No 4, Dec 79 pp 99-103

TEXT OF ENGLISH ABSTRACT:

**Abstract.** The experimental results on fabricating the bipolar ECL silicon IC by ion implantation are reported. The resistor and transistor base doping has been accomplished by implanted boron, while the emitter doping by implanted phosphorus. The average delay time per gate of the sample circuit is typically 2 ns.

The present paper is devoted to describe the effect of the implanted energy, dose, and annealing temperature and time on electrical characteristics of circuit components.

[Continuation of DIANZI XUEBAO No 4, Dec 79 pp 99-103]

The Low-Energy Nucleonics Institute of Beijing Normal University, Shanghai Municipal Bureau of Weights and Measures, Shanghai Metallurgy Institute of Chinese Academy of Sciences, and QIN Zhibin [4440 1807 1755] of Computation Techniques Institute, Chinese Academy of Sciences, provided assistance.

Received July 1978.

CSO: 4009

Geochemistry

AUTHOR: LU Yanchou [4151 3348 0321]  
YANG Xuechang [2799 1331 2490]  
JIA Rongfan [6328 5554 5358]

ORG: None

TITLE: "Quaternary Biological Sediments in the Xisha Archipelago, China, and a Discussion of the Age of Island Formation"

SOURCE: Beijing DIQIU HUAXUE [GEOCHIMICA] in Chinese No 2, Jun 79 pp 93-102

TEXT OF ENGLISH ABSTRACT: Bioclastic sediments in the Xisha archipelago were formed during the period from late Pleistocene to Holocene. Except for loose coral shell sand, they can be divided, according to petrological features, into coral reef limestone, phosphate-cemented foraminifera (or red algae and Echinodermata, etc.), calcarenite or calcirudite. All of them have been subjected to varying degrees of deuterogenia alterations, such as phosphatization, calcitization, dissolution and filling.

The age of formation of the Xisha archipelago, i.e., the time it finally emerged from under the sea, may be dealt with as: (1) Sand bars (1.5 - 3.0 meters above sea level) took shape about 2000-2500 years ago; (2) Coral reefs (3-5 meters above

[Continuation of DIQIU HUAXUE No 2, Jun 79 pp 93-102]

sea level, with the exception of rock islands) formed 4000-5000 years ago, which is in agreement with the high sea level stage in the post-glacial period; (3) Rock islands (about 15 meters above sea level) formed at late Pleistocene or earlier, which can probably be correlated with the high sea level period some 80,000-125,000 years ago.

\* Assistance was received from: LI Shenrong [2621 3234 2837], LIU Dongsheng [0491 2639 3932] and WANG Pinxian [3076 0756 0341].

AUTHOR: FU Pangqian [0265 1627 4428]  
KONG Yonhue [1313 4368 5478]  
ZHANG Liu [1728 3177]

ORG: None

TITLE: "Domain Twinning of Laihunite and Refinement of Its Crystal Structure"

SOURCE: Beijing DIQIU HUAXUE [GECHIMICA] in Chinese No 2, Jun 79 pp 103-119

TEXT OF ENGLISH ABSTRACT: Domain twinning of Laihunite has been investigated based on diffraction phenomenon, and its crystal structure has then been refined. Space group with respect to the domain is  $P2_1/b$ , and cell parameters are 4.812,  $a=10.211$ ,  $c=5.813$  ( $\text{\AA}$ ),  $\alpha=90.87^\circ$ . Atomic coordinate and bond length have been recalculated. Discussions are given to the  $\text{Fe}^{2+}$  distribution, lattice distortion, degrees of order of Laihunite and the relationship of this mineral with fayalite and ferrifayalite. The authors still hold that Laihunite should be considered a new silicate mineral with dominant  $\text{Fe}^{3+}$  and lesser amounts of  $\text{Fe}^{2+}$ .

AUTHOR: WANG Daode [3769 6670 1795]  
OUYANG Ziyuan [2962 7122 5261 6678]

ORG: None

TITLE: "A Preliminary Study on Mineral and Chemical Compositions of some Chinese Chondrites"

SOURCE: Beijing DIQIU HUAXUE [GECHIMICA] in Chinese No 2, Jun 79 pp 120-131

TEXT OF ENGLISH ABSTRACT: Samples are available for 27 stone meteorite fallings in China. Thirteen chondrites have been preliminarily examined in terms of chemical and mineral compositions, cosmogenic nuclides, formation and exposure ages, impact effect and chondrule structure. On the basis of chemical-petrological features these chondrites are classified into E<sub>4</sub> (Qingzhen), H<sub>5</sub> (Jilin, Changde, Shuangyang, Anlong, Xinyi and Yangjiang), L<sub>6</sub> (Renqiu, Junan, Heze, Rugeo and Nei Monggol) and LL<sub>6</sub> (Dongtai).

E<sub>4</sub> is characterized by high contents of iron and sulfur, with the former occurring mainly as  $\text{Fe}^0$  and  $\text{FeS}$ . From H<sub>5</sub> through H<sub>6</sub> to LL<sub>6</sub> iron and nickel decrease gradually while  $\text{FeO}$  and the ratio of Fe silicate to total iron increase gradually, indicating a general increase in the order E-H-L-LL in the extent of oxidation state at the time of formation.

[Continuation of DIGIU HUALEX No 2, Jun 79 pp 120-131]

L<sub>6</sub> consists mainly of enstatite and, to a much lesser extent, free SiO<sub>2</sub>, but olivine is hardly to be found. The olivine proportions amount to 29.07, 41.98 and 51.36 percent in H<sub>6</sub>, L<sub>6</sub> and LL<sub>6</sub> respectively, with Fe increasing from 17 to 27 percent.

Recrystallization has been noticed to different degrees in H<sub>6</sub>, H<sub>5</sub>, L<sub>6</sub> and LL<sub>6</sub> chondrites. The extent to which the original structure disappears and the boundaries of chondrules become indistinct decreases from type 6 through type 5 to type 4, reflecting the different degrees of thermal metamorphism. Major minerals in the meteorites all exhibit signs of low to intermediate impact metamorphism.

Specific activity, depth effect and orbit effect have also been measured on some chondrites that fall in recent years and some new information has been gained with respect to the orbit and source region for the meteorite parent bodies in space. These results show that the environment of formation of the L group may be nearer to Mars than the O group.

A chondrite of each chemical family has its own evolution history, and chondrites of different chemical families may have originated from parent bodies of different compositions. Or, owing to the differentiation of thermal metamorphism, different

[Continuation of DIGIU HUALEX No 2, Jun 79 pp 120-131]

kinds of meteorites may be derived from a common parent body. From this argument it is suggested that five stages may be recognized during the process of chondrite formation.

AUTHOR: MENG Xianghua [1322 4382 0563]

ORG: Changchun College of Geology

TITLE: "Phosphorite Microphase Studies of Talc-Siliceous Formation"

SOURCE: Beijing DIQIU HUAXUE [GECHIMICA] in Chinese No 2, Jun 79 pp 132-144

TEXT OF ENGLISH ABSTRACT: The two phosphatic formations distributed in Yunnan-Guizhou-Sichuan (Lower Cambrian) and Hubei-Hunan-Guizhou (Late Sinian) which were originally thought to be terrestrial carbonate deposits should be regarded as talc-siliceous formations in character as is evidenced by regional formation sequence patterns. The implications of this observation are discussed with respect to tectonic and prospecting for P, I, and other base metals. In light of a detailed investigation on microphase composition microphase zoning and those features concerning depositional environment and geochemistry, a mechanism of phosphate accumulation is proposed with special reference to the role of dynamic chemistry, f., paleotectonics and paleoclimatology. It is pointed out by the author that the proposal of chemical deposition suggested by A. V. Kazakov is in conflict with the model of microphase zonation and formation sequence patterns. Also dealt with is the relationship between the ratios of  $\text{CO}_2/\text{P}_2\text{O}_5$  and  $\text{F}/\text{P}_2\text{O}_5$  on the one hand and the mechanism of phosphate accumulation on the other.

AUTHOR: WEN Qizhong [2429 0796 1813]

YAN Jingzhou [3601 6855 1108]

DIAO Guiyi [0431 2710 0308]

YU Shuhua [0151 4790 5478]

WU Mangqiang [0702 2494 3237]

ORG: None

TITLE: "Trace Element Variations During the Reclamation of Loess"

SOURCE: Beijing DIQIU HUAXUE [GECHIMICA] in Chinese No 2, Jun 79 pp 145-155

TEXT OF ENGLISH ABSTRACT: It is evident that active Zn, Cu, Mn and substituted Mn will be gradually increasing with time after the loess is reclaimed into Dazhai farmland. The effective content of Zn has shown a remarkable increase even after a planting season within a year's time. The effective contents of Zn, Cu, Mn, Mo and B decrease from top to bottom in the soil sections of Dazhai farms. The reverse tendency is only true for active Zn in some newly built farm blocks. This may be due to the deficient supply of Zn in the newly built Dazhai fields and, therefore, good results may be expected if Zn fertilizer is used in a proper way.

AUTHOR: HONG Yetang [3163 2814 3282]  
JIANG Jiayu [5592 0046 0151]  
YU Zhicheng [0151 1807 2052]  
YAO Zaiyang [1202 0961 3057]

ORG: None

TITLE: "Environmental Geochemistry of Molybdenum and Its Bearing on Heart Health"

SOURCE: Beijing DIQIU HUAXUE (GEOCHIMICA) in Chinese No 2, Jun 79 pp 156-169

TEXT OF ENGLISH ABSTRACT: So far there has been no report on the relationship between the geochemical behavior of trace element Mo in environments and heart health. Our recent investigations of an endemic myocardial disease in special reference to the environmental geochemistry have led to the discovery that such a disease has its high occurrence in the areas where low-molybdenum-bearing terrestrial sedimentary clastic rocks, loessic deposits, igneous rocks and metamorphic rocks, as well as Quaternary deposits, are widely exposed, while the opposite tendency has been recognized in the areas dominated by marine sedimentary rocks. Evidence shows that the soils in disease-occurring areas do not favor the mobility of molybdenum due to the geochemical environment characterized by strong reduction, weak acidity and high absorption. Additionally, it has been found that the drinking water for the inhabitants is generally soft and lower in Mo content. Mo

[Continuation of DIQIU HUAXUE No 2, Jun 79 pp 156-169]

concentration in grain crops is found to be remarkably lower than that in the normal areas. Low molybdenum-bearing food crops serve as the main diet for the inhabitants in disease-occurring areas. Molybdenum concentration measurements on fodder used in animal simulating tests for alteratio meroids of cardiac muscles indicate a negative correlation between the concentration of molybdenum contained in the fodder and the degree of cardiac muscle damage of the rats being tested. However, a noticeable decrease of the degree of cardiac muscle damage would be observed if a precise addition of molybdenum is made into the fodder. Electron microscopic examination of the ultrathin sections prepared from patient cardiac muscles shows that the damage of cristil and matrix of mitochondria from cardiac muscles represents the initial alteratio meroids. This alteratio meroids caused by oxygen deficiency seems also to be related to Mo deficiency. The foregoing discussion shows that molybdenum is a beneficial element with close relationship to heart health and would do much good for the protection of the hearts of human bodies.

Data cited in the present paper from foreign literature also indicate the same tendency that molybdenum concentration is generally lower in the environments, diets and human bodies in the areas where cardiovascular disease highly occurs. The environmental geochemical behavior of molybdenum and its bearing on heart health may provide new clues to worldwide research on the relationship between trace elements and cardiovascular diseases.

AUTHOR: LI Shebbing [6221 4801 2671]

ORG: None

TITLE: "A Contribution to the Genesis of Rich Magnetite Deposit of the Gangchangling Type -- In the Light of Graphite Discovered in It"

SOURCE: Beijing DIQIU HUAXUE [GEOCHIMICA] in Chinese No 2, Jun 79 pp 170-177

TEXT OF ENGLISH ABSTRACT: Graphite has been identified for the first time from rich magnetite ores in Gangchangling, northeast China. It is suggested that the deposit originated from siderite of sedimentary origin through regional metamorphism. In view of the unique characteristics of its geological setting and mineral assemblage this deposit should be classified as a new type in China.

AUTHOR: WU Shi [0124 1395]

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TITLE: "A Study on Isotopic Geochronology of Late Proterozoic Bandong Intrusive Massai, Guangxi, China"

SOURCE: Beijing DIQIU HUAXUE [GEOCHIMICA] in Chinese No 3, Sep 79 pp 187-194

TEXT OF ENGLISH ABSTRACT: It is stratigraphically evident that the Bandong granodiorite massif intruded into the late Proterozoic Szupu Group and is unconformably overlain by the Banxi Group. The isotopic age of the massif has been measured by U-Th-Pb, Rb-Sr, and K-Ar methods. The age from the Wetherill concordia curve of accessory minerals (1100 m.y.), U-Th-Pb monazite age (1100 m.y.), in which the four groups of internal ages are close to each other, and Rb-Sr total-rock isochron age ( $1063 \pm 95$  m.y.) are in good agreement within the measured error. The initial  $\text{Sr}^{87}/\text{Sr}^{86}$  ratio is  $0.7001 \pm 0.0039$  and two Rb-Sr internal isochron ages are 406 and 410 m.y. respectively.

It is concluded from the results that (1) Bandong massif was formed  $1063 \pm 95$  m.y. ago. The magma from which the massif was derived must have come from the mantle; (2) A strongest metamorphism occurred about 410 m.y. ago after the formation of the

[Continuation of DIQIU HUAXUE No 3, Sep 79 pp 187-194]

massif, and (3) The Banxi Group of south China is stratigraphically equivalent to the Qingbaikou Group in the Yanshan region of north China. The Sazu Group orogeny movement leading to the unconformity between the Sazu and Banxi Groups corresponds to the Jingyu orogeny movement in the Yanshan region.

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ZHENG Shuhui [6774 3219 5610]  
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ORG: None

TITLE: "Oxygen Isotopic Composition of Magnetite in Pre-Sinian Fe-Bearing quartzite in the Area of Luan Xian County, Hebei Province"

SOURCE: Beijing DIQIU HUAXUE [GEOCHIMICA] in Chinese No 3, Sep 79 pp 195-201

TEXT OF ENGLISH ABSTRACT: The BrF<sub>5</sub> technique was adopted in extracting oxygen from magnetite. The measurements have shown that the samples from the Sijiaoyin mining district have the  $\delta^{18}\text{O}$  values of -5.50 - +7.58‰ with a range of 13.08‰. The  $\delta^{18}\text{O}$  values are higher for samples from the northern and southern parts of the mining district, varying within a small limit, while they are lower in the central part, with a wide range. The  $\delta^{18}\text{O}$  values of ores subjected to alteration caused by chloritization and pyritization turn out to be much lower. As for rich ores, two aspects are recognized as follows: (1)  $\delta^{18}\text{O}$  is close to that of poor ores; (2)  $\delta^{18}\text{O}$  is remarkably lower than that of poor ores, indicating a more complex mode of occurrence of rich ores.

AUTHOR: LIU Pang [0491 1627]

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TITLE: "Geological and Petrological Characteristics and Genetic Type of the Fanjingshan Basic and Ultrabasic Rocks, Guizhou Province"

SOURCE: Beijiang DIQIU HUAXUE (GECHIMICA) in Chinese No 3, Sep 79 pp 202-210

TEXT OF ENGLISH ABSTRACT: The Fanjingshan group, located in the Mt. Fanjing Region, Guizhou Province, is a flysch formation with a thickness of over 10,000 meters.

Intrusive basic rocks, varying in thickness, consist mainly of layered gabbro-diabase and diabase. Hornfels, spotted slets and albite-quartz-slets are commonly recognized in hanging and foot wall rocks as a result of contact metamorphism. Spilitic with pillow structure, averaging about 100 meters in thickness, is also widespread.

Ultramafic rocks have relatively limited occurrence, accounting for only 13 percent of the total thickness of the intrusives. Alpine ultrabasic rocks have not been found as separate mass. Ultramafic products resulting from in-situ differentiation are noticed and can be assigned to the iron series of ultrabasic rocks.

The intrusive basic rocks are classified as subvolcanics that intruded at shallow

[Continuation of DIQIU HUAXUE No 3, Sep 79 pp 202-210]

depths. They are considered to share a common source, to have emplaced into the same position and to be contemporaneous with the sea floor volcanic-spilitic, and, in accordance with its characters, should be assigned to ophiidite suit.

\* The following provided assistance: YAN Shutian [3601 2885 2905], Guizhou Geology Bureau, WANG Yangeng [3769 4291 5087], No 106 Geologic Team, ZHOU Meiji [0719 5399 1015], No 115 Geologic Team, FU Tongtai [0265 0681 3141] and ZHANG Nianchun [1728 1819 1504], both of the No 106 Geologic Team, and CHE Liqian [6508 4539 7816].

AUTHOR: ZHAO Bin [6392 2430]  
WANG Shengyuan [3769 5116 6678]  
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ORG: None

TITLE: "The Origin of Migmatite Granite and Its Relation with Iron Deposits -- An Experimental Study"

SOURCE: Beijing DIQIU HUAXUE [GEOCHIMICA] in Chinese No 3, Sep 79 pp 211-221

TEXT OF ENGLISH ABSTRACT: Experiments have been conducted over a wide range of temperatures and pressures (300-950°C, 500-2000 bars) in an attempt to gain some better understanding of the geological features of Precambrian migmatite granite and banded iron formation (BIF) widespread in northeast China. Results indicate that BIF of the Anshan type is unstable under the action of sufficient alkaline solutions with some iron or aluminum silicates formed at the expense of quartz. Rock melting experiments show that the beginning-of-melting temperatures of phyllite, biotite plagioclase gneiss and migmatite granite range from 630 to 640°C, but those of BIF and plagioclase amphibolite are 150-200°C higher. The authors suggest that migmatite in this region has resulted from partial melting and metasomatism.

[Continuation of DIQIU HUAXUE No 3, Sep 79 pp 211-221]

With respect to the relation between migmatization and iron deposits, it has been experimentally revealed that migmatite will not "digest" the BIF if they are separated by other country rocks. However, melting to various extents will take place in BIF where the migmatite is in direct contact with it. Additionally, the BIF will become even richer in iron under favorable conditions. This information may help in guiding our efforts to prospect for Precambrian iron deposits in regions with extensive occurrence of migmatite.

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ORG: None

TITLE: "The Calculation of Crystal Field Spectra of  $Cu^{2+}$  Ions in some Minerals of Low Symmetry"

SOURCE: Beijing DIQIU HUAXIE [GEOCHIMICA] in Chinese No 3, Sep 79 pp 222-230

TEXT OF ENGLISH ABSTRACT: Reported in this paper are the expressions for the crystal field potential energy and perturbation matrix elements for the symmetry of  $C_{4v}$ ,  $D_{2h}$  and  $C_i$ , by which the crystal field spectra of  $Cu^{2+}$  ions in the minerals, such as metatorbernite, conichalcite and turquiose, have been calculated. In our calculation, the values of  $(x^2)$  and  $(x^4)$  are determined by the empirical radial-wave function cited from Zhao. The results obtained are essentially consistent with the experimental data.

AUTHOR: WANG Shu [3769 2562]

ORG: None

TITLE: "The Influence of Mineral's 45° Position Accuracy on Anisotropic Rotation Measurement"

SOURCE: Beijing DIQIU HUAXIE [GEOCHIMICA] in Chinese No 3, Sep 79 pp 231-238

TEXT OF ENGLISH ABSTRACT: Correlation has been discussed and theoretical formula developed between the 45° position accuracy of anisotropic mineral and the magnitude of anisotropic rotation angle  $\Delta_{pp}$ . A great number of calculations show that if a small error is allowed in quantitative measurement of the anisotropic rotation angle the mineral may be kept in a position between  $\psi_1$  and  $\psi_2$  (or  $\psi_3$  and  $\psi_4$ ) rather than accurately in the 45° position. The interval between  $\psi_1$  and  $\psi_2$  varies from a few to over 10 degrees. Thus, the procedure by which accurate 45° position of anisotropic mineral is measured will be greatly simplified.

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TITLE: "On the Geological Ages of Granitic Rocks in Southeastern China and Their Geochronological Division"

SOURCE: Beijing DIQIU HUAXUE [GEOCHIMICA] in Chinese No 3, Sep 79 pp 239-248

TEXT OF ENGLISH ABSTRACT: In the present paper a further discussion is given on the genetic relations between orogenic movements and the formation of granitic rocks. These two major geological processes affected one another, thus leading to the formation of the continental crust and its evolution. It seems undoubted that Hercynian granites are closely related to the Hercynian orogeny, especially in the Qinzhous Region.

Based upon the geological evidence and geochronological data, the geological time-scale for the granites of different ages is proposed as follows: Dongganian granites -- approximately from 1450 to 1300 m.y.; Haushfengian granites -- from 1000 to 650 m.y.; early-Caledonian granites -- from 570 to 420 m.y.; late-Caledonian

[Continuation of DIQIU HUAXUE No 3, Sep 79 pp 239-248]

granites -- from 420 to 340 m.y.; Hercynian granites -- from 300 to 250 m.y.; Indosinian granites -- from 250 to 185 m.y.; early-Yanshanian granites -- from 185 to 137 m.y. and late-Yanshanian granites -- from 137 to 67 m.y.

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TITLE: "Spark Source Mass Spectrometric Analyses of some Iron Meteorites from China"

SOURCE: Beijing DIQIU HUAXUE [GEOCHIMICA] in Chinese No 3, Sep 79 pp 249-255

TEXT OF ENGLISH ABSTRACT: Iron meteorites from Nandan, Guangxi; Wushika, Xinjiang; Shangdu, Hebei and Huangling, Hubei are investigated with a spark source mass spectrometer for their Cr, Ni, Co, Cu, Zn, Ga, Ge, As, Mo, Ru, Rh, Pd, Os and Ir contents. The accuracy of the results and the factors affecting it are discussed. It is also preliminarily concluded that, while textural evidence of these meteorites is also taken into account, the Nandan, Wushika and Shangdu meteorites belong to IA, IIIA and IIIE groups respectively. The Ni, Ge and Ga contents in the Huangling iron meteorite come close to those of mesosiderites.

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TITLE: "Capillary GLC-MS Identification of Steroids and Hopane in the Oil Shales from an Oil Field in North China"

SOURCE: Beijing DIQIU HUAXUE [GEOCHIMICA] in Chinese No 3, Sep 79 pp 256-260

TEXT OF ENGLISH ABSTRACT:  $5\alpha$  and  $5\beta$  cholestanes, ergostane, stigmastane, hopane, etc., as well as 4-methyl- $5\beta$ -stigmastane, have been identified in a Tertiary oil

[Continuation of DIQIU HUAXUE No 3, Sep 79 pp 256-260]

shale sample from the oil fields in north China, using capillary gas-liquid chromatography-mass spectrometer. The results show that steroids occur in large amounts and great varieties, which thus provides an indication of their origination probably being from higher plant debris.

AUTHOR: None

ORG: Cooperation Group, Institute of Geochemistry, Institute of Atomic Energy, Chinese Academy of Sciences \*

TITLE: "A Study on Cosmogenic Nuclides in the Qingzhen Enstatite Chondrite and Various Types of Meteorites Falling Recently in China"

SOURCE: Beijing DIQIU HUAXUE [GEOCHIMICA] in Chinese No 3, Sep 79 pp 261-265

TEXT OF ENGLISH ABSTRACT: The measurements of cosmogenic radionuclides in various types of meteorites falling recently in China are presented in this paper. In particular, a full discussion is given to the provenance of the Qingzhen enstatite chondrite. Based upon the measured  $\text{Al}^{26}$  specific activity, an estimation has been made of the aphelion of the Qingzhen orbit ( $q' \leq 1.9$  AU). Therefore, it is concluded that the provenance of enstatite chondrites may be much closer to the sun as compared with other types of meteorites.

\* The following took part in the study: ZHOU Xiaoxia [0719 1420 7209], SONG Shaoyi [1345 4801 0308] and LI Ruixiang [2621 3843 7449].

9717  
CSO: 4020

Geology

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TITLE: "Coelenterate Fossils from the Sinian System of Southern Liaoning and Its Stratigraphical Significance"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 3, Aug 79 pp 167-172

TEXT OF ENGLISH ABSTRACT:

The present paper deals with the Sinian coelenterate and other fossils from S. Liaoning. This fauna contains 4 genera, among which 1 genus and 5 new species are described, namely, *Cyclomedusa gracilis* Xing et Liu sp. nov., *C. minus* Xing et Liu sp. nov., *C. simplicis* Xing et Liu sp. nov., *Medusinites simplex* Xing et Liu sp. nov., *Liaoningia fuxianensis* Xing et Liu gen. et sp. nov.

AUTHOR: LIN Baoyu [2651 1405 3768]

ORG: Chinese Academy of Geological Sciences

TITLE: "The Silurian System of China"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 3, Aug 79 pp 173-191

TEXT OF ENGLISH ABSTRACT:

The present article deals with the following contents:

1. According to the difference in bio-physicochemical conditions under which the sediments were deposited, the Silurian of China is divisible into 10 sedimentary provinces (See Table 1 and Fig. 1): (1) the Hingan Province; (2) the Tianshan—Neimongol Province; (3) the Tarim Province; (4) the Qilianshan Province; (5) the Kunlun—Qinling Province; (6) The Xizang—Western Yunnan Province; (7) The Yangzi Province; (8) the Himalaya Province; (9) the Jiangnan Province and (10) the South China Province.

[Continuation of DIZHI XUEBAO Vol 53, No 3, Aug 79 pp 173-191]

2. The lower limit of the Silurian. The Wufeng shale with its *Dicellograptus szechuanensis*--*D. anceps* fauna can be correlated with the Ashgillain of Britain. Locally there is a *Dalmanitina*-bearing formation of limestone, marl or mudstone, separating the overlying Lower Silurian black shale from the underlying Wufeng black shale. The Wufeng shale belongs to the Upper Ordovician.

The age of the *Dalmanitina* bed has been a topic of long debate. In China most of the palaeontologists are inclined to consider it as a part of the Upper Ordovician, on the grounds that: (1) the associated corals, brachiopods and the trilobite are more closely akin to those of the underlying Ordovician; (2) it is stratigraphically below the lower most Silurian horizon of *Glyptograptus persculptus*; (3) the *Dalmanitina* bed represents a different facies and is an equivalent of the shale with *Diplograptus bohemicus* or *Dicellograptus anceps*.

3. The upper limit of the Silurian. In China the Silurian—Devonian boundary is drawn at the base of the *Monograptus uniformis* Zone, *Icriodus worschmidti* Zone or *Warburgella rugolosa sinensis* Zone.

4. The Silurian System of China is divisible into three series and six stages: Longmaxian; Shiniulanian; Baisha'an; Xiushanian; Guandian; Miaogao'an (See Table 1).

5. Correlation of Chinese and World Silurian System (See Table 2).

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6. For the Silurian faunas three distinct zoogeographical provinces in China—The Junggar-Hingan Province, the Yangzi province and Xizang—Western Yunnan province are recognized.

7. During the Silurian Period eight marine realms, more or less interconnected, may be distinguished (Figs. 3, 4): (1) the Hingan—Junggar sea; (2) the Tianshan—Neimongol sea; (3) the Qilianshan sea; (4) the Kunlun-Qinling sea; (5) the Xizang—West Yunnan sea; (6) the Himalaya sea; (7) the Yangzi sea and (8) the South China sea.

8. The Silurian Oldlands of China include: (1) The Northeastern China; (2) the North China; (3) Junggar; (4) Tarim and Qaidam; (5) Jiangnan; (6) Kangdian; (7) Huaxia.

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TITLE: "The Devonian System of China"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 3, Aug 79 pp 192-202

TEXT OF ENGLISH ABSTRACT:

The Devonian System of China is chiefly distributed in the Tianshan-Hingan Geosyncline of North China, the Yangtze Paraplatform of South China and in the geosyncline areas of West China. In the central region, Devonian formations are entirely absent in Sino-Korean Paraplatform and Tarim Platform, but along the border of the Tarim Basin and the south and north slopes of Qilianshan, they are represented by continental sequences rich in vertebrate and plant fossils. According to the difference in depositional conditions the Devonian is divisible into 8 regions: I. Junggar-Hingan, II. South Tianshan, III. Qilianshan, IV. Longmenshan-Qinling, V. South

[Continuation of DIZHI XUEBAO Vol 53, No 3, Aug 79 pp 192-202]

China, VI. Southeastern China, VII. West Sichuan-North Xizang and VIII. Himalaya-West Yunnan Region.

On the bases of both lithostratigraphic and biostratigraphic characteristics 5 principal types may be further differentiated: 1, Hingan type (Eugeosynclinal facies); 2, Baoxing type (Miogeosynclinal facies); 3, Xiangzhou type (Platformal near-shore facies); 4, Nandan type (Platformal off-shore facies); 5, Cuifengshan type (Continental facies).

The Devonian of South China being known by its various depositional types, has a well defined stratotype. Studies on the Devonian biota have contributed greatly to the understanding of the Devonian of this region over a period of 20 years. Beginning from 1959 the Devonian of South China has been classified by the Chinese geologists into 8 stages as follows: Upper Devonian —— Hsikuangshanian, Shetienchiao-nian; Middle Devonian —— Tungkanglingian, Napiaonian (Yintangian); Lower Devonian —— Tangdingian (Sipainian), Yukienian, Naknolingian, Lianhuashanian.

The Devonian of the geosynclinal regions of West China is characterized by a faunzone of graptolites and tentaculites. Having been influenced by polygene tectonic movements, the rocks were locally deeply metamorphosed. The Devonian biota of the Junggar-Hingan Region is essentially an endemic one, but it is associated with a

few European and North American elements. Marine pyroclastics are the principal rocks. The continental Devonian of China is unique especially in the light of its vertebrate contents. The red sandstone of the Early Devonian is well developed, and intercalated with argillaceous limestone and mudstone. This sequence is rich in East Asian faunal elements including both agnathans and fishes, such as *Galeaspis*, *Polybranchiopsis*, *Funnanolepis*, etc. which form a typical endemic fauna. In the Middle Devonian, the principal rocks consist of red and light colour quartzose sandstone and mudstone in Southeastern China, with some red sandstone in both South and North China, while the fauna and flora are of cosmopolitan character. The vertebrates taxa appeared in geological ages which differ from those of similar taxa in other regions of the world, for example, *Asterolepis* and *Bothriolepis*.

This paper was read in the International Symposium on the Devonian System 1978 (P. A. D. D. 78), held in Bristol, Britain.

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ZHU Zhizhi [2612 1807 4160]  
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TITLE: "On the Liufengguan Flysch"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol. 53, No. 3, Aug. 79 pp. 203-218

TEXT OF ENGLISH ABSTRACT:

The Liufengguan flysch here refers to the early Triassic flysch formation of the Liufengguan group in the East Qinling nicrosyncline. It is characterized not only by typical flysch features such as rhythmic sedimentation of turbidites and cast molds, but particularly by cyclic sedimentation forming a cyclic sequence. A cyclic sequence is composed from below upwards of the following strata: arenaceous flysch, argillaceous flysch and thin-bedded non-rhythmic limestone. The first two are

turbidites, while the latter is not turbidite. The alternation of turbidites and non-turbidites gives rise to a cyclic sequence. The period during which no turbidites are deposited is called a break of turbidite sedimentation. The cyclic sedimentation differs from the rhythmic sedimentation in that the former is not restricted to the sedimentation of turbidites, whereas the latter is characteristic of turbid currents. From the genetic point of view, such a cyclic flysch sedimentation reflects the duration of turbid currents. It may show the following features: (1) the intensity of turbid currents is characterized by the repeated change from strong to weak; (2) the turbid currents are intermittent; and (3) the break of turbidite sedimentation indicates a period during which the earth's crust is relatively stable. The study of cyclic sequences and their cyclicity is of great significance in deciphering the origin of turbid currents and their dynamic processes.

Professor HUANG Jiqing [7806 3078 3237] provided counsel. QIN Deyu (4440 1795 0151) assisted in collecting data. SONG Tianrui [1345 1131 6904] and ZHANG Qinwen [1728 0530 2429] assisted in writing. CAO Enrong [2580 1869 2837] and WANG Youxiong [3769 0645 2646] prepared drawings. GUO Fenjiu [6753 7685 0046], CHEN Dianfeng [7115 3013 6265] and ZHAO Liyu [6392 7812 1342] provided photographs.

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TITLE: "Color Index of the Reflection Color of Ore Minerals"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol. 53, No. 3, Aug. 79 pp. 219-231

#### TEXT OF ENGLISH ABSTRACT:

This article deals with the method of color measurement and the results of 103 minerals surveyed. The process of measurement is after the projection proposed by H. pillar, i.e. first to determine the reflectivities at certain selected wavelengths with which the reflectivity dispersion curve is drawn, and then to calculate the color indices on the Hardy's selected ordinates with Se as light source.

[Continuation of DIZHI XUEBAO Vol 53, No 3, Aug 79 pp 219-233]

Every mineral is specified with five numbers, namely:  $R_m$ ,  $x$ ,  $y$ ,  $\lambda$ ,  $P$ . Occasionally more than one set of color indices are calculated from different specimens for comparison. By means of 10 interference filters, the reflectivities are measured with 10 wavelengths: 405 nm, 436 nm, 480 nm, 526 nm, 546 nm, 589 nm, 644 nm, 656 nm, 664 nm, and 700 nm. For certain minerals of pronounced variation in the curves the intervals of monochromatic light are probably too large.

In the last part of this article the authors discuss the distribution character of the common ore minerals in the chromatic chart, the error of measurement and the problem of classification of color gradation in practical work.

It is very much desired that in the description of the reflection color of ore minerals, the objective method of measurement will replace the subjective one in the near future because of its reliability and high accuracy.

AUTHOR: WU Siben [0702 1835 2609]  
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TITLE: "A Preliminary Study on the Trend Surface Analysis of Mineralogical and Geochemical Characteristics of the Zhongjiu Iron Ore Deposit and Its Ore-Forming Process"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 3, Aug 79 pp 234-246

TEXT OF ENGLISH ABSTRACT:

The present paper deals with the calculation of the mineralogical and geochemical data from the Zhongjiu iron ore deposit in the Lower Changjiang Valley by using trend surface analysis method. These data include the total iron, S and P content in orebodies,  $TiO_2$ ,  $V_2O_5$  and Ga content in magnetite, the refractive indices of phlogopite and the decrepitation temperature of magnetite.

The pictures obtained from the calculations show the characteristics of distribution and relationship of the elements stated above, the probable oreforming vapour-hydrothermal channel and the evidences of the migration direction of the hydrothermal fluid.

[Continuation of DIZHI XUEBAO Vol 53, No 3, Aug 79 pp 234-246]

Generally speaking, the refractive indices of phlogopite in the orebodies are higher than those in the country rocks. The refractive indices of phlogopite are gradually decreasing away from the orebody. The phlogopite in orebody shows also a regular variation in refractive indices, that is, the higher ones appear to be in the probable hydrothermal channels.

In most cases, the trend surface diagram for the decrepitation temperature of the magnetite is similar to that for the refractive indices of the phlogopite except for the north-western part of the orebody. In general, the decrepitation temperature of the magnetite in the orebody is gradually decreasing away from the hydrothermal channel, but within the north-western part of the orebody it is increasing upward instead of decreasing. This exceptional case is believed to be produced in the fractured zone in the upper part of the orebody, where the hydrothermal fluid, rich in volatile components, was probably under a boiling condition when the pressure decreased abruptly.

In the northern part of the deposit, TiO<sub>2</sub> and Ga contents in magnetite appear to be related to the depth and form of the orebody. The trend of the varying curve of TiO<sub>2</sub> and Ga contents is similar to that of the shape of the orebody. Their contents decrease with depth toward the deduced hydrothermal channel.

[Continuation of DIZHI XUEBAO Vol 53, No 3, Aug 79 pp 234-246]

In the south part of the deposit the refractive indices of phlogopite, the decrepitation temperature of magnetite and TiO<sub>2</sub>, V<sub>2</sub>O<sub>5</sub> and Ga contents in magnetite in the orebody gradually decrease from the internal zone to the periphery of the orebody.

As to the total iron and S contents in the orebody there exists an inverse relationship. The distribution of P content is, to a certain extent, similar to that of Fe, but the most concentrated localities of them are different.

WU Xuanzhi [0702 1357 1807] conducted calculations on an electronic computer. LI Yingqin [2621 5593 3237] and WEI Jiaxiu [7614 1367 4423] measured the temperature of magnetite. GUO Wenkuai [6753 2429 7608], YE Zhizheng [2814 3112 6927] and HU Shouxi [5170 2219 1153] revised the draft and provided counsel.

AUTHOR: ZHANG Shouyue [1728 1108 6390]

ORG.: Institute of Geology, Chinese Academy of Sciences

TITLE: "The Corrosion of Carbonate Rocks and Development of Karst (With Hubei, Sichuan, Guangxi as Examples)"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] (in Chinese) Vol. 53, No. 3, Aug. 79 pp. 247-261

#### TEXT OF ENGLISH ABSTRACT:

All surface and subsurface karstic features are made by the corrosion of carbonate rocks by natural waters.

First, results of corrosion tests made on the relative soluble velocity or "relative corrosivity" of carbonate rocks show that relative corrosivity is mainly controlled by the composition of carbonate rocks and that the amount of relative corrosivity of limestone is higher than that of dolomite. The erosional amount of carbonate rocks including both dissolution and disintegration depends on the texture and genesis of carbonate rocks.

[Continuation of DIZHI XUEBAO Vol. 53, No. 3, Aug. 79 pp. 247-261]

Next, the solubility tests of carbonate rocks by the natural waters of different hydrogeochemical types generally show that dolomite has a higher solubility than limestone. Dolomite is more soluble in the natural water of sulphate type, but both dolomite and limestone are not soluble in the natural water of chloride type. These results show that development of karst varies with different types of carbonate rocks under different hydrogeochemical environments.

1) a term proposed by the author to denote the relative degree of corrosion of carbonate rocks in karst regions.

AUTHOR: None

ORG: None

TITLE: "The Geological Society of China Holding The Fourth Congress and Electing New Leadership"

SOURCE: BEIJING DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 3, Aug 79 pp 262 & 264

TEXT OF ENGLISH ABSTRACT:

The Fourth National Congress of the Geological Society of China was held from March 26—30, 1979 in Beijing (Peking), at which the 32th Council with 157 members was formed. In addition, two vacancies for the Councillors of the Society are kept for the geologists from Taiwan Province.

Prof. Huang Jiqing (T.K. Huang) is elected as the new President.

The new Vice-Presidents are elected as follows:

[Continuation of DIZHI XUEBAO Vol 53, No 3, Aug 79 pp 262 & 264]

Cheng Yuqi, Sun Dianqing, Xu Jie (Hsü Chieh),

Yuan Jianqi, Xu Keqin, Ma Xingyuan,

Yin Zanxun, Zhang Wenyou, Lu Yanhao,

Chen Guoda, Zou Jiayou, Zhang Bosheng,

Zhu Guoping, Yur Senxun, Yu Jianzhang,

Hou Defeng, Gao Jianming, and Zhai Guangming.

Wang Zeju is engaged to be the Secretary-General of the Geological Society of  
China

CSO: 4009

Geology

AUTHOR: FAN Jiasong [5400 0857 2646]  
LI Juying [2621 5468 5391]  
ZHAO Shengcai [6392 3932 2088]

ORG: None

TITLE: "A Basic Model of the Ancient Marine Environment for Sedimentation of Carbonate"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] in Chinese No 4, Oct 79 pp 287-301

TEXT OF ENGLISH ABSTRACT:

The results of our preliminary studies on the Middle Devonian, Late Permian and Middle Triassic carbonate facies from Guizhou province and the Early-Middle Triassic from Sichuan are given as follows.

1. Facies pattern of the Middle Devonian in Guizhou Province

There the facies pattern of the Middle Devonian was controlled by the Central-Guizhou landmass extending in an east-west direction. In the region from Guiyang to Longli, Duyun and Kaili, the deposits are represented by offshore terrigenous clastics composed of mainly quartzites with subordinate mudstones and dolomites.

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 287-301]

The Central-Guizhou landmass was intermittently uplifted during the Middle Devonian, supplying much terrigenous clastics to form the offshore deposits. A wide transgression took place perhaps by late Middle Devonian, when the carbonate deposits with prolific stenohaline fauna (corals and stromatoporoids) were developed.

Further south in Huishui and Changshun districts, there developed a carbonate platform after the name of Huishui-Changshun. In this carbonate sequence are intercalated two layers of quartzite which show that the offshore terrigenous deposits derived from the central Guizhou landmass extended to the carbonate platform. Along the margin of this platform there is a series of reefs composed of corals and stromatoporoids. However, these organisms could not constitute a huge reef owing to the interference of terrigenous clastics.

In this region from Ziyun and Luodian to Nandan, south of the carbonate platform, the Middle Devonian is represented by open marine basin deposits, consisting chiefly of grey and greyish black thin-bedded calcareous mudstones with some siliceous shale, marls and sandstones. Moreover, these deposits also contain abundant pelagic (planktonic and nektonic) fauna, such as *Tentaculites*, *Hyolithes*, Trilobites and ammonites.

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 287-301]

The carbonate platform extends further south in the Wangmo-Anlong area, judging from the general lithologic characters, despite the scarcity of outcrops and insufficient data.

### 2. The Late Permian sedimentary facies in East Yunnan-South Guizhou

In this region the Niushoushan landmass was gradually uplifted, supplying a large amount of terrigenous clastics during the Late Permian, and in the Weining and Shuicheng districts very thick coal-bearing terrigenous clastics were deposited presumably in terrestrial swamps or paralic swamps. Toward the south-east near Guanling there occur deposits that are transitional between terrestrial or paralic clastics to platform carbonate.

Further south-eastward, in the Ziyun, Wangmo and Ceheng counties there appears again the carbonate platform, the margin of which is dotted with many reefs composed of calcareous algae, sponges and bryozoans and they may extend as barrier reefs.

Further on in the same direction the carbonate platform deposits are replaced by carbonate shelf deposits composed mainly of cherty limestones and thin-bedded siliceous rocks.

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 287-301]

### 3. The sedimentary facies of the Middle Triassic in Guizhou Province

The facies-change belt extends over the whole Guizhou in a nearly NE to SW direction. On both sides of this belt, the lithology and life assemblages differ greatly from one other. On the north-west side are predominantly carbonate rocks, while on the south-east clastics, and the differ remarkably in thickness. Hence the north-western part of this belt is called the carbonate platform of south-west Guizhou. Along its margin are a great number of reefs, e. g. the Qingyan and Nidang localities. On the south-east side of the belt exist open sea basin deposits of fine clastics with some limestones, siliceous rocks and turbidites as well, which contain pelagic ammonites and thin-shell bivalves (such as *Halobia*, *Daonella* and *Posidonia*).

### 4. The sedimentary facies of the early stage of Early Triassic Feixianguan Formation, Sichuan Province

During the early stage of Early Triassic, the Feixianguan Formation was formed with two different types of deposits. To the west of Huayingshan and Qingshanling mountains, it is represented by purplish terrigenous clastics, while around the Sichuan-Yunnan massive it is made up of purplish-red sandstone and conglomerates. It becomes finer and finer towards the east resulting in fine-grained sandstone, sandy shale and mudstones.

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 287-301]

East of Huayingshan and Qingshanling mountains as the supply of terrigenous clastics decrease in amount, an alternation of carbonate and terrigenous clastics appears.

From eastern Sichuan to western Hubei, especially along the Mts. Fangdoushan and Qiyueshan, the Feixianguan Formation changes abruptly in its lithology. The third member of this Formation contains a large amount of oölites and bioclastic grains which form the shallow bioclastic and oölitic shoal.

#### 5. The sedimentary facies of late Early Triassic Jialingjiang Formation, Sichuan Province

During the late Early Triassic, the Jialingjian Formation was deposited on a very gentle eastward slope. Starting from the sedimentation of Lower Jialingjiang (the first and second members of the formation) regression took place over Sichuan, though it was interrupted by small-scale advances and retreats of the sea. During the sedimentation the Sichuan-Yunnan landmass was gradually uplifted and supplied plenty of terrigenous clastics, thus the lower Jialingjiang was mainly composed of purplish-red clastics and was spread to the west of Qingshanling mountain. However, east of this mountain clastics gave way to micrites, oölites (bioclastic limestone), dolomite and anhydrites. Obviously the major transgression was followed by a regression, and the anhydrites-dolomites-skeletal and/or oölitic limestone appear to the east of Qingshanling.

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 287-301]

#### 6. The sedimentary facies of the Middle Triassic (Badung Formation and Leikoupo Formation) in Sichuan basin.

During the early Middle Triassic the Xuefeng landmass was rapidly uplifted and became a provenance of terrigenous clastics. As a result purplish-red clastics were widely spread east of Huayingshan mountain, involving eastern Sichuan and western Hubei, such clastics represent offshore terrigenous deposits, named as Badung Formation.

West of Huayingshan the entire central Sichuan can be considered as a typical evaporitic basin, where the deposits are chiefly composed of carbonates and evaporites (Leikoupo Formation).

Further westward, broad open sea basin deposits predominate with abundant pelagic thin-shell bivalves and ammonites.

XIE Cuihua [6200 5050 5478] assisted in writing the paper. Professor YE Lianjun [5509 6647 0193] revised the draft and provided counsel.

Received 21 August 1978.

AUTHOR: FENG Zengzhao [7458 1073 2507]

ORG: East China Petroleum College

TITLE: "A Preliminary Discussion on the Lower Ordovician Litho-Facies and Paleogeography in North China"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] in Chinese No 4, Oct 79 pp 302-313

TEXT OF ENGLISH ABSTRACT:

This article covers the following three aspects:

1. From the study on paleontology, petrology and stratigraphy, it is demonstrated that the Lower Ordovician and Upper Cambrian dolomites and their underlying dolomitic limestone so widely distributed in North China could not be regarded as being chemically precipitated from the so-called saline sea i.e. not forming a sedimentary-stratigraphic unit; on the contrary they were formed as a result of replacement or dolomitization.

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 302-313]

2. Starting from the observation the author presents some new views on the nature of the so-called Sanshanzi Formation and the boundary between Cambrian and Ordovician systems.

3. On the basis of observations given above and many basic figures, a map of litho-facies and paleogeography for the Yeli Formation of North China has been compiled. On this map are shown the old land, old sea, shallow bank, restricted sea, open sea or inter-bank sea etc. In addition, the characteristics of the lithofacies and paleogeography of the Liangjiashan Formation are also discussed here.

The Hebei First Territorial Surveying Brigade, Geology Institute of Beijing Municipal Geology Bureau, Fengfeng Mining Bureau, Geology Institute of Chinese Academy of Sciences, and various oil fields in North China provided support.

Received 16 February 1978.

AUTHOR: CAI Xuelin [5591 1331 2651]  
ZHU Guoqiang [4555 0948 1730]  
ZHANG Bonan [1728 0130 0589]  
SHI Shaoqing [4258 4801 3237]

ORG: All of the Chengdu Geologic College

TITLE: "The Textural Analysis of the Strain-Slip Cleavage"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] in Chinese No 4, Oct 79 pp 314-321

TEXT OF ENGLISH ABSTRACT:

This article discusses the classification, the textural features and the formation mechanism of the strain-slip cleavage, through megaseopic and microscopic analysis of them in the epimetamorphic rocks of the Tongan and Weishan districts.

The cleavage planes are closely spaced and parallelly arranged with slips of 0.5 mm to several mm. Most of the microlithon's planes are separated from one another by a width of about 0.02—0.05 mm. Newly formed flaky minerals in the cleavage planes are always oriented and form angles of 5°—15° with the general direction of the cleavage plane, the size of the angle being directly proportional to the

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 314-321]

width of microlithons and inversely proportional to the lateral stress. There are four kinds of extinction on the cleavage planes.

Varieties of plications or microplissements are developed in the microlithons. According to their morphological features the strain-slip cleavage may be classified into six types:

1. The slipfold-shaped strain-slip cleavage;
2. The chevronfold-shaped strain-slip cleavage;
3. The stromatolite-like fold-shaped strain-slip cleavage;
4. The undulating fold-shaped strain-slip cleavage;
5. The thrustfault-shaped strain-slip cleavage;
6. The "S-flexure"-shaped strain-slip cleavage.

The strain-slip cleavage is formed not simply through shearing force or compressing force, but results from the compressive force combined with shearing force, that is, it must be formed under the lateral compression by which the cleavage formed in differential shear stress along the direction normal to compressive force, if the beds concerned are laminated or schistose.

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 314-321]

LIU Ling [0491 3781] and YANG Jiahe [2799 1367 0735] prepared drawings and photographs. XU Kaili [1776 7030 4409] and LIU Fuhui [0491 4395 6540] provided counsel.

Received 1 February 1978.

AUTHOR: XIA Cheng [1115 3821]  
CHEN Kaihui [7115 7030 1920]  
JI Surong [1213 4790 2837]

ORG: None

TITLE: "New Recognition of the Kaolinite Minerals From Gaoling Village"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] in Chinese No 4, Oct 79 pp 322-329

TEXT OF ENGLISH ABSTRACT:

The Gaoling village is well known the world over as the original site of kaolin. In the region around the village there occurs the "Fuliang" granite intrusive mass with different lithologies ranging from medium-grained biotite to medium-grained muscovite and medium-grained porphyritic granites and so on. The intrusive mass was locally cut by pegmatites. Regional kaolins are extensively distributed in the region as a result of weathering of the medium-grained muscovite granites and pegmatites.

In the past, some workers held that the kaolin minerals were mostly composed of poorly crystallized kaolinites in the Gaoling village: but three varieties of kaolins were

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 322-329]

collected by us from the region: (1) sandy kaolin; (2) vein-like kaolin and (3) massive kaolin. These samples have been determined by various methods, such as X-ray powder diffraction, DTA, TGA, IR, chemical analysis and kaolinite minerals observed by TEM. It is considered that the kaolinite minerals under study consist chiefly of endellite and halloysite with only a small amount of poorly crystallized kaolinite.

The Jingdezhen Municipal Bureau of Science and Technology as well as the related units under Jingdezhen Chinaware Industrial Company provided support in field work and sample collection. The Electron Microscope Laboratory of Light Exposure Institute and the ninth office of authors' institute [no name mentioned] engaged in indoor work. KUANG Taishan [6782 3141 1472], HAN Xiuling [7281 4423 3781], ZHANG Zhenyu [1728 2182 4416], WU Meiqing [0702 5019 3237] and ZHAO Huimin [6392 1920 2404] assisted in various mineral analyses. ZHOU Jingliang [0719 2529 5328] and SU Mingdi [5685 2494 6611] revised the draft and provided counsel.

Received 28 August 1978.

AUTHOR: GUO Xudong [6753 2485 2639]

ORG: None

TITLE: "Sea Level Changes Since Late Pleistocene in China"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] in Chinese No 4, Oct 79 pp 330-341

TEXT OF ENGLISH ABSTRACT:

Geological investigations made recently in a coastal regions and continental shelf have offered some definite evidences on the sea level changes in China during Late Quaternary. Some peat and peaty deposits have been found in the bottom of the Bohai sea, the north Huanghai Sea and the East China Sea. It is especially interesting that from the continental shelf of the East China Sea, were also found bones of big terrestrial mammals, brackish-water mollusks, shallow-water marine mollusks (relict shells), peaty deposits as well as charcoal. Three chenier ridges are preserved on the continental shelf of the Bohai and the Donghai near Tianjin and Shanghai. Generally, raised coral reefs or coral limestones are distributed in the tropical areas along the South China Sea, such as Hainan island, Xisha island, south Taiwan and Nansha islands.

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 330-341]

According to by dating radiocarbon 14 the sea level was higher about 40000 yrs. B. P. than today in the East China Sea. It dropped 36000 years ago at a depth of 70—80 m below the present level. Since then, the sea level rose slowly to a depth of -40 to -30 m at 25000—20000 years B. P. and it once again dropped to about -110 m 15000 yrs B. P. Therefore, the author is inclined to regard the lowest strand line to be existing 15000 yrs ago, while the Qomolangma Feng glacial stage (maximum Würm) reached its maximum glacier advance.

During the postglacial stage, the sea level rose slowly until it was higher by 5—7 m than the present level 5000—6000 yrs ago. The highest strand line during Holocene may have appeared 6000 yrs ago. The sea level was higher by 3—4 m than today's level 3500—2500 yrs ago. About 1800 yrs ago the sea level had a tendency to drop and finally 200 to 70 yrs ago it changed especially remarkably with an amplitude greater than that in other parts of the world.

Many climatic records related to the changes of sea level during Late Pleistocene indicate that sea level changes agree with the advances of continental glaciers and the evolution of ancient organism and that they are related to climatic fluctuations on land.

Received 17 July 1978.

AUTHOR: LI Dingrong [2621 7844 1369]  
PENG Yimin [1756 0001 3046]  
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TONG Youde [4547 2589 1795]

ORG: LI and XIE of Seismic Geology Brigade, State Seismic Bureau, PENG of Wuhan Geology College; LIU of Beijing Normal University; and TONG of Prospecting Team Beijing Mining Bureau

TITLE: "Subdivision of Pliocene-Pleistocene Series in Beijing Plain"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] in Chinese No 4, Oct 79 pp 342—349

TEXT OF ENGLISH ABSTRACT:

A *Hyalinea-balthica* (marine foraminifera) assemblage was found by authors in cores taken from the base of Quaternary Shunyi county and other localities. Its study reveals an ingressional taking place by Early Quaternary in area concerned. Taking the paleomagnetic data into account the local subdivision of the Cenozoic is worked out as follows: Pliocene Shunyi Formation ( $N_1^{sh}$ ); Pleistocene Xiadian Formation ( $Q_1^p$ ), Zhaili Formation ( $Q_2^{sh}$ ), Junying Formation ( $Q_3^p$ ) and Holocene Series ( $Q_s$ ).

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 342-349]

In this paper the lithologic, petrographic and paleontologic characteristics of the Pliocene Shunyi and Pleistocene Xidian Formations are described in details. The Pliocene-Pleistocene boundary is placed at the base of the index beds composed of marine sands containing the *Hyettina-bathymena* assemblage and may be correlated with the level of the Matuyama Gauss polarity change (2.43 m.y. B.P.).

The Third Laboratory of the Chinese Academy of Sciences, Nanjing Geology and Paleontology Institute, Vertebrate Paleontology and Anthropology Institute, Beijing Municipal Institute of Geology, and Guiyang Geochemistry Institute provided support. ZHANG Fenglan [1728 7685 5695] and LIU Zhan [0691 3277] took part in analysis and sample treatment. MENG Shuhua [1322 3219 5478] and ZHOU Yuqing [0719 3768 0615] prepared drawings.

Received 19 January 1979.

AUTHOR: ZHAO Xitao [6392 1585 3447]  
PENG Gui [1756 6311]  
ZHANG Jingwen [1728 2529 2429]

ORG: All of the Institute of Geology, State Seismological Bureau

TITLE: "A Preliminary Study of Holocene Stratigraphy and Sea Level Changes Along the Coast of Hainan Island"

SOURCE: Beijing DIZHI KEXUE (SCIENTIA GEOLOGICA SINICA) in Chinese No 4, Oct 79 pp 350-358

#### TEXT OF ENGLISH ABSTRACT:

Radiocarbon datings of several profiles of Holocene sediments have enabled us to subdivide and correlate these profiles in relation to sea-level changes. Preliminary conclusions are given as follows.

1. Several index stratigraphic units have been established, i.e. the Luhuitou raised coral-reef, formed in the middle stage of the Middle Holocene (5200—4900 yrs. B.P.); the Luhuitou formation composed of coral sand, gravels and secondary reef was formed in the middle and late stages of the Middle Holocene (about 4300 yrs. and 3800—3600 yrs. B.P.), and the Yandun formation (marine sands and sandstones)

[Continuation of DIZHI KEXUE No. 4, Oct 79 pp 350-358]

and the Haikou formation (laguna clayey sand and sandy clay) deposited in the early and middle stages of Late Holocene (2200—2000 yrs. and about 1600 yrs. B. P.) respectively.

2. The middle-late Holocene beachrocks can be further divided into two kinds, the Lubutou and the Yandun ones (about 3750 and 2000 yrs. B. P. respectively).

3. Evidences for four higher sea levels (dated 5200—4900, 4300, 3800—3600 and 2100—1800 yrs. B. P. respectively) along the coast of Hainan Island are found in the Holocene.

YU Xiangyu [4416 4382 5940], XUE Wanjun [5641 5502 0193], LI Yuanshan [2621 0117 1472], PENG Wenke [7458 2429 4430], MIAO Xiangshan [4924 4382 1472], ZHANG Zhonglu [1728 0112 6922], JIAO Wenqiang [3342 2429 1730], LI Damin [2621 1129 2494] and LI Liying [2621 2710 5391] took part in field and indoor research work.

Received 23 November 1978.

AUTHOR: YI Liying [0122 7787 3853]  
GUO Tuoju [6753 7094 5468]

ORG: YI of the Institute of Geology, Chinese Academy of Sciences and GUO of the Gulin Institute of Metallurgical Geology

TITLE: "The Complete Semimicro-Analysis of Zircon"

SOURCE: Beijing DIZHI KEXUE (SCIENTIA GEOLOGICA SINICA) in Chinese No. 4, Oct 79 pp 359-373

#### TEXT OF ENGLISH ABSTRACT:

This report introduces a more successful method for decomposing the infusible minerals, that is, all zircon minerals can be sintered and completely decomposed in a platinum crucible at a temperature of 520°C by using sodium peroxide as a flux. It is satisfactory to quantitatively separate them from the associated elements by depositing zirconium and hafnium with p-bromomandelic acid and using tartaric acid as a masking agent in 2*N* hydrochloric acid. This procedure is more favorable than the available method of mandelic acid in many aspects, such as less amount of reagent, fixed precipitation composition, small conversion factor, higher accuracy, as well as less loss of platinum. 6—6*N* nitric acid is selected as eluting agent to smoothly separate

[Continuation of DIZHI KEXUE No 4, Oct. 79 pp 359-373]

the highly inseparable rare earth, uranium and thorium. The analysis is made through a chromatographic paper treated with tri-n-octylamine to carry on the reversed phase chromatography. The *Rf* values obtained are 1.0, 0.40—0.48 and 0.056 for rare earth, uranium and thorium respectively. The separation is satisfactory for their ratio of from 1:100 to 100:1. In the presence of high amount of zircon, the silicon in large amount is determined by means of silicomolybdate blue spectrophotometry and using EDTA as masking agent. And the ethyl alcohol is utilized as stabilizing agent for increasing the accuracy and stability in determination of silicon.

Besides, this paper has proposed a simple and rapid method of complete analysis of zircon, permitting the determination of 16 elements from sample of 20—30 mg, such as Zr, Hf, Si, Fe, Ca, Mg, Mn, Al, TR, U, Th, Be, P, Nb, Ta and Ti. This method is proved to be fairly successful through practical tests and calculation of mineral composition.

Received 8 September 1978.

AUTHOR: Li Yuwen [2621 3768 2429]

ORG: Chengdu Institute of Geology and Mineral Resources

TITLE: "On the Negation of Sichuanian Movement."

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] in Chinese No 4, Oct 79 pp 374-377

TEXT OF ENGLISH ABSTRACT:

Studies made during the last few years have thrown doubts on the validity of Sichuanian movement proposed by C. Y. Li. First in many areas the Cretaceous and Paleogene are conformable with each other, thus denying any movement at the end of Cretaceous or between Cretaceous and Tertiary.

Second, the "Tunghu Conglomerate" in eastern Sichuan and western Hubei now known to contain Cretaceous reptiles, namely Meglosauridai, Hadrosauridai, Titanosauridae and Ceratosauria is no more belonging to Late Eocene in age as reported by C. Y. Li. It overlies unconformably the "Kueichow Series" of Jurassic, hence this unconformity indicates one phase of Yanshanian cycle, leaving no room for Sichuanian movement.

[Continuation of DIZHI KEXUE No. 4, Oct 79 pp 374-377]

On the whole, the Sichuanian movement is but a tautonym of the Himalayan cycle, Yanshanian cycle and Indosinian cycle already known in different parts of China. Consequently the name "Sichuanian movement" should be abandoned.

Received 18 April 1978.

AUTHOR: SHA Qingan [3097 1987 1344]  
PAN Zhengpu [3382 2973 5455]  
WANG Yao [3769 1031]

ORG: None

TITLE: "Recent Dedolomitization in the Vadose Zone"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] in Chinese No 4, Oct 79 pp 378-384

TEXT OF ENGLISH ABSTRACT:

This article describes and discusses the dedolomitization developed along joints of two outcrops of limy dolomite (Middle Ordovician). The maximum width of the two dedolomitized zones reaches 20 cm and 7 cm respectively. According to the occurrence and other evidences of dedolomitization, it is supposed that the dedolomitization resulted from the action of sub-recent near-surface vadose water. The rock fabrics produced by dedolomitization are characterized by: (1) replacement of the surrounding dolomite by the calcite, by which the dolomite may either remain as a small inclusion or disappeared

[Continuation of DIZHI KEXUE No 4, Oct 79 pp 378-384.]

altogether; (2) the contact boundaries of calcite crystals are at first sinuous, intersecting each other, but later on, the calcite crystals are gradually recrystallized with perfect crystal faces. In fact, this kind of dedolomitization may be regarded as a metasomatic-replacement-recrystallization under normal pressure and temperature.

SUN Shu [1327 2873] and FENG Zengzhao [7458 1073 2507] revised the draft and provided counsel. CHEN Lihua [7115 7787 5478], WANG Wenyiing [3769 2429 3841] and WANG Xiulan [3769 4423 5695] of authors' institute [name not mentioned] assisted in the work. In addition, Petroleum Prospecting and Exploration Institute of Petroleum Industry Ministry as well as Geology and Minerals Institute of Chinese Academy of Geology Sciences provided assistance.

Received 17 August 1977.

CSO: 4009

Geology

AUTHORS: YANG Zijeng [2799 1111 6342]  
LI Youjun [2621 1635 6511]  
DING Qifuling [0002 4428 3781]  
HE Baocheng [0149 1405 2052]

ORG: All of the Geologic Team 7 of Hebei Geologic Bureau

TITLE: "Some Fundamental Problems of Quaternary Geology of Eastern Hebei Plain"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 4 Sep 79 pp 263-279

TEXT OF ENGLISH ABSTRACT:

In the eastern Hebei plain Quaternary deposits of about 600 and 300 meters occur respectively in downwarped and upwarped areas. The beginning of the Quaternary is taken at 3 millions years before present corresponding to that of geomagnetic Mammoth event. During the Quaternary period, according to climatic indications, five glacial and four interglacial climatic stages can be differentiated. In this part there are also discovered seven marine ingestions, taking place either in interglacial or mid-glacial and post-glacial stages. The Holocene can be subdivided into early, middle and late stages, among which the middle one the warmest. A short cooling stage was found to have taken place about 5000 years before present.

[Continuation of DIZHI XUEBAO Vol 53, No 4 Sep 79 pp 263-279]

SUN Dianqing [1327 3013 0615] of Chinese Academy of Geological Sciences, SUN Xiangjun [1327 3276 0689] of Botany Institute, Chinese Academy of Sciences, DU Hengjian [2629 1854 0313] of Wuhan Geology Institute, and WANG Bingchen [3769 4426 1820] of Changchun Geology College revised the draft. SHEN Fengji [3088 7685 4764] prepared drawings.

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ORG: Institute of Geology of the Chinese Academy of Geological Sciences

TITLE: "New Advances on the Lower and Upper Boundaries of the Ordovician System in China"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 4 Sep 79 pp 280-292

TEXT OF ENGLISH ABSTRACT:

The disputed problems of the Lower and Upper boundaries of the Ordovician system have attracted the attention of many stratigraphers and palaeontologists in different countries. In China there are many continuous Ordovician/Silurian or Cambrian/Ordovician sequences, containing a great variety of fossils, which may serve to solve the boundary problems.

Basing upon the lithologic and biostratigraphic correlation of 11 sections, which show the passage from the Upper Ordovician to the Silurian, the following conclusions are made:

[Continuation of DIZHI XUEBAO Vol 53, No 4 Sep 79 pp 280-292]

1. The base of *Hirnantia* and *Dalmanitina*-bearing beds is diachronous, and so is the top of the *Dalmanitina*-bearing beds. If the Ordovician/Silurian boundary is placed at the base of the *Glyptograptus persculptus* zone, as done at present in China, it should be drawn at the top of the *Hirnantia*-bearing beds, if the latter fauna is present, but it can't be placed at the top of the *Dalmanitina*-bearing beds, as the latter fauna ranges into the *Glyptograptus persculptus* zone, even up to the *Akidograptus acuminatus* zone.

2. The *Paraorthograptus-Diceratograptus mirus* zone of China is considered equivalent to the top of the *Dicellograptus anceps* zone of Britain. The *Hirnantia* stage (uppermost Ashgill Series) is correlated to the *Diplograptus bohemicus* zones of the Wufeng stage. While the *Diplograptus bohemicus* zone corresponds probably to the *Climacograptus extraordinarius* zone.

The Cambrian/Ordovician boundary was formerly placed differently in various regions of China. In the Jiangnan region it was placed as low as the base of the Lower Tremadocian, while in the Qilian region it was set as high as the base of the Upper Tremadocian.

Discoveries made recently from the once-called the uppermost Cambrian strata —— *Onychopyge* from the Fengshan formation of Tangshan and *Anisograptus*, *Dicyonema* from the Fengshan formation of Benxi and *Drepanodus simplex* from Sanyoutung group of Yichang —— indicate the Cambrian/Ordovician boundary falls within the uppermost Fengshan formation or Sanyoutung group and Loushankwan group. Biostratigraphically this boundary at present lies between the *Onychopyge Assemblage* or *Staurograptus-Hysterolenus* zone and *Calvinella-Mictosaukia* zone.

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and HAO of Aerial Prospecting Brigade, Ministry of Geology

TITLE: "Tectonics of the North China Platform Basement"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 4  
Sep 79 pp 293-304

TEXT OF ENGLISH ABSTRACT:

The aeromagnetic anomaly fields over the basement of the North China platform may be grouped into four main types: (1) regional anomaly field composed of discrete local anomalies with short axis that are characterized by big magnitudes and appreciable changes in positive and negative values, (2) wide and gentle-sloping bands of positive or negative anomalies of moderate magnitudes, (3) banded, gentle-rising or declining anomaly field, and (4) bands of linear magnetic anomalies.

An attempt is made to outline the tectonic evolution of the North China platform basement on the basis of the five megastages of the Archaeozoic and early Proterozoic Eons. The occurrence of a small tract of 3.5-b.y.-old continental crust in the Qianzi-

[Continuation of DIZHI XUEBAO Vol 53, No 4 Sep 79 pp 293-304]

Zunhua area in eastern Hebei suggests the earliest tectonic differentiation. The Qianxi megastage that occurred 3.5 to 3.0 b.y. ago is characterized by the development of continental nucleus. The North China embryo-platform took shape during the Fuping megastage at the end of the early Archaeozoic Eon, about 2.5 b.y. ago. Afterwards, in the early Proterozoic, crustal evolution persisted into the rudimentary and proto-geosyncline and -platform stage, and eventually, about 1.7 b.y. ago, the basement of the North China platform was consolidated.

Tectonic elements of different generations are sifted out from the integrated tectonic framework of multiple deformation occurring within individual major cycles, and on that basis the authors establish the tectonic sequence, elucidate the deformational history and paleo-structural types of the basement of the Archeozoic and early Proterozoic North China platform, and also discuss the distribution of dykes and dyke swarms and their significance.

Facts indicate that the basement of the early Precambrian North China platform grew not only by peripheral accretion but also by cyclic cratonization and subsequent disruption and disintegration as well as repeated activation of mobile belts developing along fundamental deep faults during various megastages. In comparing various tectonic megastages, it can be noted that during the course of tectonic evolution the anrogenic duration became shorter and shorter, while the tectonic activity was gradually intensified and the differentiation became pronounced.

[Continuation of DIZHI XUEBAO Vol 53, No 4 Sep 79 pp 293-304]

LI Wanheng [2621 5502 0077] and PO Kuangao [2613 1401 6964] provided counsel. JIANG Chunyan [5592 2504 5333], TANG Yuanqing [0781 6678 3237] and CHAO Hui [1560 2547] prepared drawings.

AUTHOR: LI Chunyu [2621 2504 2509]

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TITLE: "Plate Tectonic and Polycyclic Orogenesis"

SOURCE: BEIJING DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 4 Sep 79 pp 305-315

TEXT OF ENGLISH ABSTRACT:

Whether a geosynclinal fold zone is monocyclic or polycyclic evolution, chiefly depends upon the character of a geosyncline and our recognition of it. According to the traditional concept, a geosyncline is a depression trough in a land-mass or a mobile zone between two land-masses. That makes it difficult to get a satisfactory explanation for the polycyclic orogenesis, although they widely exist. The plate tectonic theory holds that most of the geosynclines tend to occur around the continental margins, where the sediments of various epochs were deposited. When the sedimentary zone was compressed because of the movement of crustal plates, the strata were folded with vergence usually towards oceanic side. Subsequently an underthrust was derived and further a subduction or sometimes an obduction zone would be for-

[Continuation of DIZHI XUEBAO Vol 53, No 4 Sep 79 pp 305-315]

med. The original geosyncline became a land to form a part of the old land-mass, while in the oceanic side a new geosyncline appeared. Through the repetition of these processes, a result of polycyclic orogenesis would naturally happen. The domain between the Qilian Mountain to the north and Ximalaya (Himalaya) Mountains to the south in southwestern China is a typically developed polycyclic tectonic region. The presence of such orogenic movements as Caledonian, Variscian, Indo-sinian, Yenshanian and Himalayan in this region serves a good evidence to prove the polycyclic evolution of its tectonics.

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TITLE: "Crystal Field Spectra and Infrared Spectra of Chromium-Containing Pyropes"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 4 Sep 79 pp 316-322

TEXT OF ENGLISH ABSTRACT:

In the present paper crystal field spectra and infrared spectra are given for the chromium-containing pyropes. This mineral has a space group Ia3d ( $O_h^{+}$ ) with Cr<sup>3+</sup> ions on the octahedral site. The two strong absorption bands as observed in crystal field spectra are characteristic of Cr<sup>3+</sup> in 6-fold coordination, and they are attributed to the spin-allowed transition in Cr<sup>3+</sup>, ' $\Lambda_{1g} \rightarrow ^{\prime}T_{2g}$ ' and ' $\Lambda_{1g} \rightarrow ^{\prime}T_{1g}$ '. Crystal field splitting parameter is given by  $D_q = \frac{1}{10} \nu_1$ . Crystal field stabilization energy of Cr<sup>3+</sup> ions in pyropes has been calculated.

[Continuation of DIZHI XUEBAO Vol 53, No 4 Sep 79 pp 316-322]

The infrared spectra of three pyropes are similar. Site group and factor group methods have been used for analyzing infrared spectra. Five infrared active internal vibrations for SiO<sub>4</sub> tetrahedron were predicted by site group analysis. Seventeen infrared active vibrations were predicted by factor analysis, but only a part of the seventeen bands was observed in 1400—200 cm<sup>-1</sup> range. The internal mode distribution in SiO<sub>4</sub> tetrahedron is given by factor group analysis.

LI Youqin [2621 1635 3830] provided support.

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TITLE: "The Metallogenetic Specialization of Acidic-Intermediate Igneous Rocks Related to Iron and Copper Deposits of the Eastern Part of China"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 4 Sep 79 pp 323-336

TEXT OF ENGLISH ABSTRACT:

Numerous facts and chemical analyses have shown that the "ore-forming" igneous rocks are commonly characterized by high alkalinity.

"Iron-ore-forming" igneous rocks (except granites) are commonly sodium-rich and highly alkaline. The values of the petrochemical parameters such as a, n, Na' and a/e etc. are notably higher than normal. "copper-ore-forming" igneous rocks are commonly potassium-rich and of highly alkaline, and the values of petrochemical parameters, such as a, k', n' and a/e etc. are commonly higher than normal.

[Continuation of DIZHI XUEBAO Vol 53, No 4 Sep 79 pp 323-336]

In consequence of their high alkalinity, the "ore-forming" igneous rocks always undergo wide and intense alkali-metasomatism, which is closely related to the formation of ore deposits.

Alkali-metasomatism also has its metallogenetic specialization: sodium-metasomatism is closely related to the formation of iron deposits, while potassium-metasomatism to the formation of copper deposits.

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TITLE: "On the Replacement Zoning of Certain Strata-Bound Copper Deposits"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 4 Sep 79 pp 337-350

TEXT OF ENGLISH ABSTRACT:

On the basis of geological observations and experimental studies of some strata-bound copper deposits found in the variegated rock series in S. China, the author has compared such deposits with some important strata-bound copper deposits abroad. Considering also the calculated thermodynamic data of the multi Cu-Fe-S-O-H-Cl system under low temperature conditions, it is here proposed that the zoning of this type of copper deposits is the product of replacement of which the ore-bearing solution — the ground water and the rising connate water circulating in the rock series — replaces the base metal-stabilizers, such as pyrite, marcasite and H<sub>2</sub>S.

From the oxidized phase to the reduced phase of the variegated rock series, there exists a series of metallogenetic elements, such as Cu, Ag, Hg, Au, Se, U, V, Co, Cd, Pb, Zn, Ni, Mo, Re, Sb, As. Owing to the change of physical and chemical conditions of the geological settings, especially the variation of Eh and pH, and more importan-

[Continuation of DIZHI XUEBAO Vol 53, No 4 Sep 79 pp 337-350]

tly, the difference in the sulfur affinities, the reactions of the replacement of the base metal-stabilizers by these elements will follow the Schürmann's Law, and progress with the increasing of solubility product, and the decreasing in the difference between free energies prior to and after the reaction. Those with stronger sulfur affinity will replace pyrite and other stabilizers earlier, and remain in the posterior zone. Others, with weaker sulfur affinity, will replace pyrite and other stabilizers later, and form the front zone. This gives rise to the zoning of this type of copper deposits. From the front to the posterior the zonal deposits can be divided into: (1) syngenetic pyrite zone, (2) base metals replacement and reduction front zone, (3) base metals replacement and reduction progressive zone, (4) base metals replacement and reduction enriched posterior zone, and (5) base metals remoulded posterior zone.

Furthermore, the time of mineralization with reference to diagenesis, the evidence for the replacement zoning and the mechanism of the zoning of the copper deposits are discussed, and a comprehensive zoning pattern is suggested.

{Continuation of DIZHI XUEBAO Vol 53, No 4 Sep 79 pp 337-350}

LI Nuo [7812 6179], CHEN Wenming [7115 2429 2494] and the related personnel of geology brigades contributed in the research.

AUTHOR: LIU Qun [0491 5028]  
XU Deming [6079 1795 2494]

ORG: Both of the Chinese Academy of Geological Sciences

TITLE: "Classification of Potash Deposits and Its Significance for Prospecting"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese Vol 53, No 4 Sep 79 pp 351-362

TEXT OF ENGLISH ABSTRACT:

The proposed classification of potash deposits is a result of many years of related scientific investigations in China and also a synthetic study of the geological data of more than twenty-five major potash deposits in other parts of the world.

Based chiefly on their characters of mineralization and sedimentation, types of related saline formation and sedimentological features of the saline sequence, the potash deposits may be classified into two major types, i.e., the chemical and terrigenous detrital-chemical. With further consideration of the five categories of the sedimentological features of the saline sequence, the chemical type is divided into three subtypes and the terrigenous detrital-chemical, two subtypes.

[Continuation of DIZHI XUEBAO Vol. 53, No. 4 Sep 79 pp 351-362]

The chemical type belongs to the carbonate-sulfate-salt formation and was formed in rather deep-water or moderate-deep-water basins of the relatively stable regions. During the chemical sedimentation of the deposits, evaporation played a predominant role with the brine under well differentiated conditions. The zoning of the potash deposits is thus quite clear, showing a successive distribution of carbonate, sulfate to chloride from the margin towards the center of the basin.

The terrigenous detrital-chemical potash deposits are found in the detritals-rock salt formation of the red or variegated series and are distributed in the relatively mobile regions such as intermontane basin, graben, and continental rift valley, etc., were formed in shallow-water basin with a clear periodic water-feeding. Sedimentation seems to be quite complex. The alternations of detrital and chemical rocks form distinct multi-cycloths. The potash beds are numerous but not stable.

The elucidation of the depositional characteristics of the potash deposits of various types, of the conditions of their formation, and of the regularities of their distribution both in time and space will not only be of help to point out the direction of ore-finding and methods of prospecting for potash deposits, but also beneficial to further studies of the metallogenetic problems concerned.

[Continuation of DIZHI XUEBAO Vol. 53, No. 4 Sep 79 pp 351-362]

Professor YUAN Jianqi [5913 6015 7871] of Wuhan Geology College revised the draft and provided counsel.

CSD: 4009

Oceanology and Limnology

AUTHOR: LING Heibei [3677 0271 0271]

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TITLE: "A Study of the Laws of Small-Scale Horizontal Turbulent Diffusion Near the Chinese Coastal Areas"

SOURCE: Beijing HAIYANG YU MUZHAD [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese No 1, Jan 80 pp 1-12

TEXT OF ENGLISH ABSTRACT: Using a two-dimensional statistical model, the mechanism of the horizontal turbulent diffusion field in the sea is discussed in this paper. By correlation analysis, the experimental data of 30 tests in 8 areas along China's coastal waters are investigated, from which the fundamental parameters of horizontal turbulent diffusion due to isotropic and small-scale eddies are obtained. Furthermore, the basic laws of turbulent diffusion in sea water off the Chinese coast are obtained as  $K = 0.0025U^2t$  and  $K = 0.05Ul$ . It shows that the relationship between the coefficient of diffusion and the dimension of the cloud released is a linear one, contrary to the usually accepted law of 4/3 power.

AUTHOR: ZHANG Binggen [1728 3521 2704]

ORG: Shandong College of Oceanology

TITLE: "On the Maximum of Wave Surface of Sea Waves"

SOURCE: Beijing HAIYANG YU MUZHAD [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese No 1, Jan 80 pp 13-20

TEXT OF ENGLISH ABSTRACT: This article considers wave surface as a normal stationary random process to solve the estimation of the maximum of wave surface in a given time interval by means of the theoretical results of probability theory. The results are represented by formulas (13)-(19) in this article. It was proved in this article that when time interval approaches infinite, the formulas (3), (6) of  $E\{\eta_{max}\}$  that were derived from the references (Carterright, Longuet-Higgins) can also be derived by asymptotic distribution of the maximum of wave surface provided by the article. The advantage of the results obtained from this point of view as compared with the results obtained from the references was discussed.

AUTHOR: SHEN Jianzhu [3008 1696 2691]  
CHEN Enjiau [7215 1069 0036]

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TITLE: "The Characteristics of Monsoonal Circulation over the Western Pacific"

SOURCE: Beijiang HAIYANG YU HUZHAD (OCEANOLOGIA ET LIMNOLOGIA SINICA) in Chinese  
No 1, Jan 80 pp 21-29

TEXT OF ENGLISH ABSTRACT: In this article we have utilized the meteorological observations on ships four times daily in the area between 0-45°N, 90-155°E. We have used the grid 2x2 degrees along our coastal waters, and 5x5 degrees over the open sea. Here the monsoon currents over the western Pacific are calculated and analyzed and we have given a brief discussion. We obtained the following three criteria:

(1) The monsoon current over the western Pacific between winter and summer changed almost in opposite directions with April and October being the transitional months. In general the wind direction change from summer to winter went from the coastal waters to the open sea.

(2) After the discussion about the duration and the prevailing wind directions, the following was determined: during the winter monsoon period, the 25°N latitudinal line may be regarded as the boundary from October to March when the winter wind

[Continuation of HAIYANG YU HUZHAD No 1, Jan 80 pp 21-29]

directions inclined N (NW or N) to the north of that line; but to the south of it NE winds prevailed. However, the durations were quite different in different regions, ranging from five to nine months. Owing to the topographic influence of the Taiwan Strait, the duration of the NE wind lasted nine months.

The 25°N line may also be applied for summer monsoons; over the eastern open ocean from the gulf of the Bohai Sea and the Japanese islands the southerly winds lasted about nine months, but in the Taiwan Strait they lasted only two months.

(3) During the winter monsoon period, the region of strong winds which encircled the continent was over the open ocean to the east of the Japanese islands and the Philippines. However, it was not as near to the shore line as in the winter season, and the frequency of strong winds was somewhat more on the southern side of the 25°N line.

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TITLE: "Marine Environmental Geochemistry. I. The Valency State of Chromium in Seawater and the Seawater-Sediment Chromium Interchange"

SOURCE: Beijing HAIYANG YU HUZHAD [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese  
No 1, Jan 80 pp 30-45

EXCERPT FROM ENGLISH ABSTRACT: A procedure for the differential analysis of dissolved Cr(III) and Cr(VI) of ppb level in seawater and natural waters has been described in this article. In this procedure, a three liter sample is filtered with a 0.5  $\mu\text{m}$  poresize membrane (the pH of seawater being kept unchanged) and divided equally into three parts. One liter is passed through an anion-exchange resin bed to remove most of the anionic Cr(VI); the cationic Cr(III) left is then coprecipitated by  $\text{Fe}(\text{OH})_3$  and analyzed. Another liter is analyzed directly for anionic Cr(VI) by spectrophotometry using diphenylcarberazide and a 10 cm cell. The third liter is analyzed for total dissolved Cr by spectrophotometry after  $\text{Fe}(\text{OH})_3$

[Continuation of HAIYANG YU HUZHAD No 1, Jan 80 pp 30-45]

coprecipitation. The non-ionic Cr concentration in the original water sample can be obtained by the difference method. The anionic portion is regarded as the Cr(VI) concentration, and the cationic + non-ionic portions are regarded as Cr(III) concentration in the original water samples.

\* The following aided in the study: HE Chungben [6378 1504 2609], LI Jiliang [2621 4949 0081], LI Tianan [2621 1131 1869], WANG Xingjian [3769 5281 1696], CHEN Guohua [7115 0948 5478], WEI Zixing [7279 1311 5281] and XIE Chuncai [5641 2504 2088].

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ORG: All of the Institute of Oceanology, Chinese Academy of Sciences

TITLE: "Mineral Assemblages and Their Distribution Patterns in the Sediments of the Gulf of Bohai Sea"

SOURCE: Beijing HAIYANG YU MUZHOU [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese No 1, Jan 80 pp 46-64

EXCERPTS FROM ENGLISH ABSTRACT: This paper presents the results of a study on the mineral assemblages and their distribution patterns in the sediments of the Gulf of Bohai Sea. The 212 bottom-surface sediment samples were collected from the Gulf of Bohai Sea and its tributaries.

The 0.1 - 0.05 mm fraction was analyzed. The results of our study showed that the sediments are made up of 43 mineral components. Analysis of the light minerals showed that plagioclase is the predominant component, quartz ranked second in abundance, and orthoclase third. A small amount of carbonate minerals and rock

[Continuation of HAIYANG YU MUZHOU No 1, Jan 80 pp 46-64]

grains was also present. In the heavy minerals hornblende, epidote and ilmenite are the most abundant, and garnet, zircon and titanite placed second. In addition, a small amount of leucoxene, muscovite, tremolite and magnetite placed third. The remaining components were present in insignificant quantities.

Sediments with high content of plagioclase, hornblende, muscovite and carbonate minerals contributed principally by the Huang He River (Yellow River) are distributed in the southern part of the Gulf of Bohai Sea, while sediments with high content of orthoclase, magnetite, ilmenite, zircon and garnet are distributed in the northern part of the Gulf of Bohai Sea. These minerals are contributed from different sources, for example, orthoclase is mainly derived from the Liao He River while the other minerals are derived from the Luan He River, the Lugu River, the marine erosion of the eastern coast of Liaodong Bay, and the Liaodong Bank.

\* The following aided in the study: LI Qing [2621 3237] and JIANG Mengrong [5592 1322 2837].

AUTHOR: PU Peimin [3450 1014 3046]

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TITLE: "A Step-Pulse Type Wave Staff Gauge of Model MDCB"

SOURCE: Beijing HAIYANG YU MUZHAD [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese No 1, Jan 80 pp 65-72

TEXT OF ENGLISH ABSTRACT: The step-pulse type wave staff gauge of model MDCB is an automatic recorder which may be used for distant measurement of the time-spatial changes of the wave water surface in rivers, lakes and oceans. The structural principles of this apparatus, the descriptions of its environmental experiments and the problems of analysis of the recorded data are described in this paper. The sensitivity or accuracy of this instrument is 1 cm for freshwater and 2 cm for saltwater. The whole staff consists of some sections in equal construction. These sections may be connected to each other so that the measurement sphere may be arbitrarily increased. The photographic recorder and the digital paper tape recorder have been used to simultaneously record the analogue (step type) and digital value of the wave water surface.

\* Aiding in this study were: ZHANG Qitai [1728 0366 3141], HUANG Xinchang [7806

[Continuation of HAIYANG YU MUZHAD No 1, Jan 80 pp 65-72]

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ORG: CHEN, LIU Peilin, LIU Renjun and LIN all of the Institute of Hydrobiology, Chinese Academy of Sciences; PILLERI of the Institute of Brain Anatomy, University of Berna, Switzerland

TITLE: "The Distribution, Ecology, Behavior and Protection of Dolphins in the Middle Reaches of the Chang Jiang River (Wuhan - Yuyang)"

SOURCE: Beijing HAIYANG YU MUZHAD [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese No 1, Jan 80 pp 73-84

TEXT OF ENGLISH ABSTRACT: Lipotes and Nephocerus inhabit mainly the mainstream of the middle reaches of the Chang Jiang River. According to date of investigation and geographical features, the Three Gorges are a geographical barrier for the distribution of the dolphins. Thus they have their limited distribution. In the different seasons they have different biotope. During the late spring and early summer, Lipotes is more or less congregated in the region of Honghu Lake, while the black finless porpoises gather also together in groups, but downstream from Honghu Lake.

[Continuation of HAIYANG YU MUZHAD No 1, Jan 80 pp 73-84]

Lipotes is a dolphin that is estranged from human beings. It is usually found in groups, several or even more than 10 individuals to stay in the deep water. When searching for fish as food or nursing their young, they may swim near to the beach of the water body. Lipotes has deep diving ability. When disturbed they escape far away so fast that it is difficult to see them again with the naked eye.

The black finless porpoise is an animal on intimate terms with human beings. They swim near the shore. Usually they appear to be in groups of three to five individuals. Occasionally there are more than 20 individuals in one group. They have an interesting and peculiar way of nursing their young which is rather rare among dolphins. The calf is usually carried by its mother on her back.

According to our observation, the numbers of Lipotes and Nephocerus in the middle reaches of the Chang Jiang River, a region from Wuhan to Changlingji, we saw about 70 individuals of black finless porpoise and only about 20 individuals of Lipotes. Although it is only a very rough estimate and the actual number must be greater, we can be fairly sure in saying that the population of Lipotes does not seem to be great at present.

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TITLE: "Studies on the 'Stigmatoisis' of Silver Carp (Hypophthalmichthys molitrix)  
and Bighead (Aristichthys nobilis)"

SOURCE: Beijing HAIYANG YU MUZHAD [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese  
No 1, Jan 80 pp 85-93

EXCERPT FROM ENGLISH ABSTRACT: Stigmatoisis is one of the bacterial diseases of the silver carp and bighead in the majority of provinces of China where it has caused high losses. According to information we have collected, it is primarily an ailment for both the fingerling and adult fish.

As the name signifies, stigma lesion is characterized by the formation of a red stigma on the surface of the body. In ordinary cases there are usually two stigmata symmetrically arranged on both sides of the latero-ventral regions just above the vent, although they may occur on other parts of the body. In its early stages the lesion appears to the naked eye as a small red spot-like outgrowth of the epidermis; this later becomes putrefied and the scales begin to fall off, and as the lesion

[Continuation of HAIYANG YU MUZHAD No 1, Jan 80 pp 85-93]

grows, the bacteria invade the dermis in an ever-enlarging circle, eventually destroying it entirely, so that it shows a great thickening of the epithelia around the bloodstained margin and makes the center a deep depression, somewhat like a Chinese seal.

\* The following helped in the study: LIU Yuanbin [0491 0337 2430] and LU Quanzhang [5684 0356 4545].

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AUTHOR: ZHANG Hongqing [1728 7703 1987]

ORG: Department of Mathematics

TITLE: "Algebraic Construction of General Solutions of Linear Operational Systems"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [ JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 1-16

TEXT OF ENGLISH ABSTRACT:

In this paper we prove the following theorem:

Let

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix}, \quad u = \begin{pmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{pmatrix},$$

in which  $a_{ij}$ —a linear operator on linear space  $M$ ,  $a_{ij} \in R$ ,  $R$ —a Commune ring.

[Continuation of DALIAN GONGXUEYUAN XUEBAO No 3, Sep 79 pp 1-16]

$$d_{j_1 \dots j_n}^{i_1 \dots i_n} = \begin{vmatrix} a_{i_1 j_1} & a_{i_1 j_2} & \cdots & a_{i_1 j_n} \\ a_{i_2 j_1} & a_{i_2 j_2} & \cdots & a_{i_2 j_n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{i_n j_1} & a_{i_n j_2} & \cdots & a_{i_n j_n} \end{vmatrix},$$

$$d_{i_1 i_2 \dots i_{k-1} i_k}^{12 \dots k-1 k} = D_k d_{i_1 i_2 \dots i_{k-1} i_k}^{12 \dots k-1 k}, \quad d_{12 \dots k-1 k}^{i_1 i_2 \dots i_{k-1} i_k} = D_k d_{12 \dots k-1 k}^{i_1 i_2 \dots i_{k-1} i_k},$$

$i_1 < i_2 < \dots < i_{k-1} \leq k$ ,  $i_k = k+1, \dots, n$ ,  $d_{12 \dots k}^{12 \dots k-1 k}$  and  $\frac{d_{12 \dots k-1 k}^{12 \dots k-1 k}}{D_k}$  Satisfy Condition Q,

$D_0 = D_1 = 1$ , then the general Solution of  $Au = 0$  is given by

$$\begin{pmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{pmatrix} = \begin{pmatrix} 0 & a_{12} & \cdots & (-1)^k d_{12 \dots k-1 k}^{12 \dots k-1 k} & \cdots & (-1)^n d_{12 \dots k-1 k}^{12 \dots k-1 k} \\ -a_{11} & \cdots & (-1)^{k+1} d_{12 \dots k-1 k}^{12 \dots k-1 k} & \cdots & (-1)^{n+1} d_{12 \dots k-1 k}^{12 \dots k-1 k} \\ \vdots & & \vdots & & \vdots \\ (-1)^{2k-1} d_{12 \dots k-1 k}^{12 \dots k-1 k} & \cdots & (-1)^{n+k-1} d_{12 \dots k-1 k}^{12 \dots k-1 k} & \cdots & (-1)^{n+k-1} d_{12 \dots k-1 k}^{12 \dots k-1 k} \\ \vdots & & \vdots & & \vdots \\ (-1)^{2n-1} d_{12 \dots k-1 k}^{12 \dots k-1 k} & & & & \end{pmatrix} \begin{pmatrix} 0 \\ \varphi_1 \\ \vdots \\ \varphi_k \\ \vdots \\ \varphi_n \end{pmatrix},$$

[Continuation of DALIAN GONGXUEYUAN XUEBAO No 3, Sep 79 pp 1-16]

where  $\varphi_k$  satisfy

$$-\frac{D_k}{D_{k-1}}\varphi_k=0, \quad k=2, \dots, n.$$

We also illustrate application of our theorem to various problems of mathematical physics.

Professor TANG Limin [0781 4539 3046] encouraged the author in writing the paper. Professors QIAN Weichang [6929 0251 7022] and HU Haichang [5170 3189 2490] provided counsel.

Received 9 February 1979.

AUTHOR: QIU Dahong [6726 1129 3163]

ORG: Power Factor Laboratory, Ocean Engineering Institute

TITLE: "A Practical Method for Calculating the Irregular Wave Forces on Piles and Piers"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 17-27

TEXT OF ENGLISH ABSTRACT:

According to the stochastic distribution of the irregular wave forces on piles, this paper gives a practical method for calculating them on the basis of Morison's wave force equation. A primary discussion on the effect of the dimension of the pier on the wave forces is also given here.

Received 1 December 1977.

AUTHOR: LIN Gao [2651 4108]

ORG: Earthquake Preparedness Laboratory

TITLE: "The Earthquake-Resistant Behavior of Concrete Gravity Dams"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 28-37

TEXT OF ENGLISH ABSTRACT:

The earthquake-resistant behavoir of different types of concrete gravity dams are studied, taking into account the average earthquake force acting on the whole dam and the induced principle stresses on the upstream face of the dam.

LOU Shulan [1236 2885 5571] took part in computation.

Received 12 May 1979.

AUTHOR: LI Luhui [2621 0712 3549]  
ZHANG Baoan [1728 1032 1344]  
LI Boji [2621 0130 7535]  
WENG Shanjing [5040 0810 5464]  
WANG Daqing [3769 1129 1987]

ORG: All of Physics and Chemistry Faculty Research Section

TITLE: "A Study on the Catalyst Selectivity in Synthesis of Alkylpyridines from Acetaldehyde"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 38-48

TEXT OF ENGLISH ABSTRACT:

In this paper, the influence of chemical species and temperature upon catalyst selectivity has been examined. It was found that phosphate of cadmium or zinc used as a catalyst behaves more advantageously in producing  $\alpha$ -picolin, especially the former, with a weight ratio of  $\alpha$ -picolin to  $\gamma$ -picolin 5-6:1. Moreover, the selectivity of the catalysts was correlated with metal ion species as well as their anionic counterparts or the like.

[Continuation of DALIAN GONGXUEYUAN XUEBAO No 3, Sep 79 pp 38-48]

A reaction mechanism involving the principal steps of the process has been proposed. By which, the experimental results with respect to catalyst selectivity might be explained to some extent.

CAI Tianxi [5591 1131 6932], WU Xiang [0702 5046], XIA Yaqin [1115 7161 3830], ZHANG Youjia [1728 2589 1367], YANG Biyun [2799 4310 4596], HOU Yongyu [0186 3057 3768] and LI Xiurong [2621 4423 5554] took part in experiments.

Received 3 May 1979.

AUTHOR: WU Rui Feng [6762 3843 6912]  
QIU Chunhang [5941 2504 5300]

ORG: WU of Engineering Mechanics Faculty Research Section; QIU of Institute of Engineering Mechanics

TITLE: "A Statistical Theory of Brittle Fracture"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 49-60

TEXT OF ENGLISH ABSTRACT:

The Weibull's chain model of strength of materials, as today's foundation of statistical theory of brittle fracture, due to its simplicity in mathematical calculation, has been widely applied and advanced in the last decades. Nevertheless, it has an obvious defect. It does not take into account the interaction between various elements of calculation and this in many cases, especially in the case of nonuniform stress field, is the main cause which leads to errors.

[Continuation of DALIAN GONGXUEYUAN XUEBAO No 3, Sep 79 pp 49-60]

The present paper, based on a large amount of experimental data attempts to put forward a hypothesis dealing with the mutual actions between adjacent elements along one direction and to correct aforesaid serious defect. The formulas obtained seem somewhat more complicated than Weibull's, but they are obviously more accurate when verified by experimental data.

Another important problem in statistical theory of brittle fracture is the studies of the distribution of strength. Based on the analysis of experimental results a model of fracture is proposed and made analytical expression that under any state of stress produces the asymptotic normal distribution.

Received 3 October 1978.

AUTHOR: LIN Shaopei [2651 1421 1014]

ORG: Institute of Engineering Mechanics

TITLE: "The Application of General Purpose Program for Structural Analysis "JIGFEX"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 61-73

TEXT OF ENGLISH ABSTRACT: This paper deals with the application of general purpose program for structural analysis "JIGFEX" from the user's point of view.

The main features of this program such as the substructuring, multielement assemblage, "Master-Slave" relationships as well as that of the finite state loading automat are discussed.

The readers can be referenced from [1], [3] in further details.

Received 29 November 1978.

AUTHOR: CHAN Haoran [7115 3185 3544]

ORG: Institute of Engineering Mechanics

TITLE: "The Application of 'Jigflex' Program for Ship hull Stress Analysis"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [ JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 74-85

TEXT OF ENGLISH ABSTRACT:

In this paper, the following aspects have to be mentioned for the application of "JIGFEX" in the ship hull stress analysis:

- (1) Characteristics of ship hull structure under loading condition;
- (2) Modellization of structure member;
- (3) Multi-level assembling in structure;
- (4) Qualification of node displacement and "Master-slave relation-hip";

[Continuation of DALIAN GONGXUEYUAN XUEBAO No 3, Sep 79 pp 74-85]

- (5) Some concrete problems about structure treatment;
- (6) Some concrete problems about data treatment.

This paper may be helpful for the designer in ship hull structure.

Received 29 November 1978.

AUTHOR: Gai Xianyan [5391 0948 8827]  
QI Naiwei [2575 0035 3128]  
LAI Guanzhang [6351 0948 3864]

ORG: LAI of Shandong Engineering College; QI and LAI of Institute of Engineering Mechanic

TITLE: "The Earthquake Hydroelastic Response Analysis of the Liquid Storage Tanks"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 86-100 & 107

TEXT OF ENGLISH ABSTRACT:

In this paper, the finite element technique is used to construct the mass and stiffness matrices of the revolutionary shell, and the finite element procedure is used in conjunction with a simple source distribution on all surfaces of a liquid, which is contained in the revolutionary shell, to drive the expressions for the mass and stiffness(because of the gravity) matrices of the liquid. Once they are obtained, they can be combined with

[Continuation of DALIAN GONGXUEYUAN XUEBAO No 3, Sep 79 pp 86-100 & 107]

those of that shell in order to analysis the earthquake hydroelastic response of the liquid storage tanks.

Two examples of the revolutionary liquid storage tanks supported by columns was discussed. Due to the circumferential deformation of the tank, caused by horizontal earthquake, is of the cosine type, we may use the concept of "substructure" to deal with the couple problem of the Fourier coefficient when the axisymmetry of the revolutionary shell was destroyed. At last, in order to simplify the earthquake response

analysis of the tank, based on the calculation above, the anti-earthquake evaluation on three examples are illustrated with the beam deformation theory, and then the approximate method to deal with the more complex problem for the structure in water is presented.

Along with it the actual measured results of that three calculated examples are descripted.

AUTHOR: SHAO Jiaozhe [7410 6411 0772]  
XU Weiming [1776 0251 2496]

ORG: SHAO of Computer Faculty Research Section; XU of Radio Plant,  
Dalian Institute of Technology

TITLE: "An A/D Converter in the Style of Comparison of Variant Integration"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF  
TECHNOLOGY] in Chinese No 3, Sep 79 pp 101-107

TEXT OF ENGLISH ABSTRACT:

The paper gives an outline of the principle of an A/D converter of CVI and analyses emphatically its conversion speed — the astringency. It also deduces the formula with which we may estimate the conversion speed. It gives an actual circuit, too. Finally, it gives the explanation about the applications of this converter and proves the correctness of the formula estimating the measured speed by experiment.

Received 13 November 1978.

AUTHOR: FENG Xinan [7458 6580 1344]  
ZHAO Shengbin [6192 5110 2430]

ORG: FENG of Dalian Institute of Technology; ZHAO of Zhengzhou Institute  
of Technology

TITLE: "The Optimum Design of a Double Composite Gear"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF  
TECHNOLOGY] in Chinese No 3, Sep 79 pp 108-121

TEXT OF ENGLISH ABSTRACT:

The double composite gear in the speed-changing and feed gearboxes  
of machine tool has been designed by trial-and-error method, and there  
was not a criterion to decide whether the quality of design was the best.  
In consequence, it was difficult to get an ideal plan quickly. In this paper a  
concept about the equivalent center distance of gear transmission was prop-  
osed. By means of this concept a number of design criterions were analysed  
and compared, and it was proposed to use the sum of the equivalent areas

[Continued] of DALIAN GONGXUEYUAN XUEBAO No 3, Sep 79 pp 108-121]

of gears as the object function to be optimized. A mathematical model was established for optimum design of double composite gear. By the calculation with a computer some graphs were given. By means of these graphs it was convenient to get an optimum version of the double composite gear according to different requirements (i. e. restrained condition).

Received 1 February 1979.

AUTHOR: GUO Keren [6753 0668 6072]  
GAO Qin [7559 2953]  
ZHANG Guoliang [1728 0948 2733]

ORG: All of Casting Faculty Research Section

TITLE: "The Study of the Ladle Inert-gas Purging Refining Process"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 122-130

TEXT OF ENGLISH ABSTRACT:

Although the ladle inert-gas purging technique is widely used in the melt-refining process, yet its theoretical aspects are still not clear. The process is investigated through simulating method with the aid of a bubble-counting laser set. The relationship between the pore diameter of the porous plug  $d$ , bubbling frequency  $f$  and rate of purging  $Q$  is established.

Continuation of DALIAN GONGXUEYUAN XUEBAO No 3, Sep 79 pp 122-130]

It is found that for a specific plug with a pore diameter  $d$ ,  $f$  increases as  $Q$  increases until a critical value  $Q_c$  is reached, with further increases of  $Q$ ,  $f$  remains unchanged up to a certain value of  $Q$ , then decreases down to a certain value. It is shown by Stoke's Law that the total reactive surface of the bubbles in the course of uprising in a water column is related to  $f$  only, irrespective of the bubble radius  $R$ , and the bubbling frequency  $f$  of a porous plug with smaller diameters is more larger than that with larger ones. The effect of purging rate on stirring action is also studied, the trend is the same as it on bubbling frequency  $f$ . It is concluded that the critical purging rate  $Q$  or near-by might be the most effective purging rate in respective to both the total efficient reactive surface and the stirring action, i. e., to degassing. It is also concluded that the results achieved through simulating method can be transferred to the melt of any alloy providing that further experiments on production basis are made.

Received 25 May 1979

AUTHOR: ZHANG Zhonglin [1728 0112 2651]

ORG: The Science Research Group of Vacuum Carburizing

TITLE: "The Research of Vacuum Carburizing"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [ JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY ] in Chinese No 3, Sep 79 pp 131-138

TEXT OF ENGLISH ABSTRACT:

This article have discussed the process of the vacuum pulsing carburizing and the characteristic of this process.

A vacuum furnace with a water cooled wall and a interior heater was used to study the effect of various factor --- time, temperature, the interior pressure of the furnace at the carburizing period and the ratio of the diffusing period to the carburizing period--- on the results of vacuum carburizing. According to the results of tests, some opinions were made.

[Continuation of DALIAN GONGXUEYUAN XUEBAO No 3, Sep 79 pp 131-138]

The rate of vacuum carburizing is four times faster than that of regular carburizing. The carbon content in the surface of the carburizing layer can be controlled by changing the ratio of diffusing period to carburizing period. The quality of the vacuum carburizing is much better than the regular carburizing.

WANG Shaotong [3769 4801 1656], CHEN Baoqing [7115 1405 3237], DENG Chunfu [6772 2504 4395], ZHOU Xingjiu [0719 3281 0036], WANG Dayong [3769 1129 1661], and CHENG Rongquan [4453 1369 1227] took part in the research.

Received 10 April 1979.

AUTHOR: LI Shangxin [7120 0810 3512]

ORG: The Teaching Group of Metallography

TITLE: "The Study of Log Chipper Knives and the Test on Gaseous Carbon-Nitrogen-Boron Penetration"

SOURCE: Dalian DALIAN GONGXUEYUAN XUEBAO [JOURNAL OF DALIAN INSTITUTE OF TECHNOLOGY] in Chinese No 3, Sep 79 pp 139-153

TEXT OF ENGLISH ABSTRACT:

In this paper the composition of materials, their mechanical properties, the metallographical and electron microscope analysis are made. In addition, the qualities of log chipper knives made in China with those made in abroad are compared, the necessary scientific data are provided to improve the qualities of chipper knives.

The causes of fracture of the chipper knives made in China are analysed. A new process on gaseous Carbon-Nitrogen-Boron penetration is tested and better results have been achieved.

CHENG Rongquan [6653 5556 1227], YU Guanghua [0151 1684 5478], HAN Shuangqi [7281 7175 6386] and CHEN Shuyuan [7115 3219 1254] took part in experiments. Luda Mechanical Chipper Knife Plant also took part in experiments. Jiamusi Paper Mill provided support. Dalian Steel Mill, Strength of Materials Laboratory (of Dalian Institute University, Shanghai), and Second Laboratory (of Metals Institute, Chinese Academy of Sciences) assisted in experiments.

Received 4 October 1978.

CSD: n009

THE STRESS FIELD OF A DISLOCATING INCLINED FAULT

Beijing DIZHENG XUEBAO [ACTA SEISMOLOGICA SINICA; SEISMOLOGICAL JOURNAL]  
in Chinese Vol 2, No 1 Feb 80 p 20

Huang Fuming [7806 4395 2494], Wang Tingyun [3769 1694 7291] Seismotectonic Brigade, State Seismological Bureau)

[Abstract] In this paper, analytical expressions of the stress field given rise by a rectangular dislocating fault of an arbitrary dip in a semi-infinite elastic medium for the case of unequal Lame constants are derived. The results of computations for the stress fields on the ground surface of an inclined strike-slip and an inclined dip-slip fault are represented by contour maps. The effects of Poisson Ratio of the medium, the dip angle, upper and lower boundaries of the faults on the stress field at surface have been discussed. As an application, the contour maps for shear stress and hydrostatic stress of near fields of the Tonghai (1970), Haicheng (1975) and Tangshan (1976) earthquakes have been calculated and compared with the spatial distributions of strong aftershocks of these earthquakes. It is found that most of the strong aftershocks are distributed in the regions of tensional stress, where the hydrostatic stress is positive.

VARIATIONS OF GRAVITY BEFORE AND AFTER THE HAICHENG EARTHQUAKE, 1975 AND THE TANGSHAN EARTHQUAKE, 1976

Beijing DIZHENG XUEBAO [ACTA SEISMOLOGICA SINICA; SEISMOLOGICAL JOURNAL]  
in Chinese Vol 2, No 1 Feb 80 p 30

Chen Yuntai [7115 6663 3141], Institute of Geophysics, Academia Sinica, present address: Institute of Geophysics, State Seismological Bureau, Gu Haoding [7357 3185 7844], and Lu Zaixun [4151 6644 0534] The Seismological Bureau of Liaoning Province.

[Abstract] Before and after the Haicheng earthquake of magnitude 7.3 which occurred on Feb. 4, 1975, five repeated gravimeter surveys were carried out, three before and two after the earthquake, along a north-west-southeast profile of about 250 km in length not far on the west of the epicenter. The mean-square error of the measurements of the gravity differences between two consecutive points on the profile is less than 40 uGal. From June, 1972 to May, 1973, within a period of about one year, the results of three surveys indicated a clear decrease of gravity values at points on the southeastern portion of the profile, amounting to as much

[continuation of DIZHEN XUEBAO No 1 Feb 80 p 30]

as 352 n Gal. After the earthquake, the fourth survey which was carried out on March, 1975, revealed that the gravity values had recovered to the levels at the first survey and continued to increase as was shown by a fifth survey carried out in July of the same year.

Variations of gravity were also observed before and after the Tangshan earthquake of magnitude 7.8 which occurred on July 28, 1976, but in this case, gravity was increasing before the earthquake instead of decreasing. Along an east-west profile of about 270 km in length and not far on the north of the epicenter, two gravity surveys were made before and two after the earthquake. The results showed that after the main shock, the gravity values of the whole profile, especially at those points closer to Tangshan, tended to return gradually to their values of the first survey before the earthquake.

From these results, there seems to be a close relationship between these gravity variations and the occurrences of earthquakes. Based on results of repeated levelling work done in these regions, the estimated amount of gravity change caused by the change of elevation of the ground surface is far too small to account for the observed value. We therefore speculate that some big earthquakes might be associated with some sort of mass migration under the ground, within the crust or in the upper mantle. This

[continuation of DIZHEN XUEBAO No 1 Feb 80 p 30]

migration would cause a large part of the gravity variation observed. We have made a theoretical analysis of this effect and attempted to get some estimate of the rate of this mass migration, even though we are not yet clear about the physics of it.

A MATHEMATICAL SIMULATION FOR THE PATTERN OF SEISMIC TRANSFERENCE IN  
NORTH CHINA

Beijing DIZHEN XUEBAO [ACTA SEISMOLOGICA SINICA; SEISMOLOGICAL JOURNAL]  
in Chinese Vol 2, No 1 Feb 80 p 42

Wang Ren [3769 0088], He Guoqi [0149 0948 3823], Yin Youquan [3009 2589 3123],  
Cai Yongen [5591 3057 1869], Peking University, Department of Geology

[Abstract] Paper describes a certain process of solving a space-time inversion problem. A certain North China region is treated as a grillage of tectonic structures composed of 24 major faults and as an elastic-ideally plastic body in plane strain at a depth of 15 km. It is subjected to uniform stress along the boundaries. By means of the finite element method, the stress field is calculated and the zones of seismic risk are delineated in this region. By reducing the coefficient of friction in a fault from static to kinetic, stress and strain energy may be released there. Five major earthquakes in the last 12 years in this region are simulated in this manner. By comparing the stress fields before and after the stress release, one obtains the change in strain energy, fault offsets, areas of seismic risk etc. They are compared to data from actual measurements. If they don't agree well, tectonic framework, parameters of mechanical properties and external stress field are adjusted until they do.

[continuation of DIZHEN XUEBAO No 1 80, p 42]

The results show that the present method can reproduce in essence the pattern of seismic transference in the last 12 years and may give some idea about the zones of seismic risk in the future. They also suggest that, after an earthquake, there are narrow sectors in the left-frontal part along the slippage directions that become safer than before, while in the remaining parts the danger of shear fracture increases.

ANOMALOUS VARIATIONS OF SEISMIC VELOCITY RATIO BEFORE THE SONGPAN-PINGWU EARTHQUAKE (M=7.2) OF 1976

Beijing DIZHEN XUEBAO [ACTA SEISMOLOGICA SINICA; SEISMOLOGICAL JOURNAL] in Chinese Vol 2, No 1 Feb 80 p 54

Feng Deyi [7458 1795 4135], Wang Zhouyuan [3769 6650 0955], Gu Jinping [7357 3866 1627] Sheng Guoying [4141 0948 5391], and Li Kelong [2621 0460 7893], The Seismological Institute of Lanchow, State Seismological Bureau.

[Abstract] Using the observational data of travel times of the direct seismic waves, recorded at the networks of seismic stations in Sichuan and Gansu provinces, the preliminary studies of the velocity ratio anomaly before the Songpan-Pingwu earthquake in Sichuan Province of August, 1976 were made. The obtained results indicate that before this earthquake the anomalous variation of the velocity ratio was quite obvious, the durations of the  $V_p/V_s$  anomaly and its recovery were rather short. The anomalous region of very large extent was located to the south of the epicentral area of the main shock within Sichuan Province. Certain features of the  $V_p/V_s$  anomaly seem to show the connection and also difference between this earthquake and the Songpan-Nanping (Ms=6.5) of August, 1973. In

[continuation of DIZHEN XUEBAO No 1 Feb 80 p 54]

consideration of the characteristics of the velocity ratio anomaly observed in this region, the related problems of its recovery and the superposition of the anomalous regions have been briefly discussed.

ANOMALOUS MIGRATION OF SHALLOW GROUNDWATER AND GASES IN THE BEIJING REGION  
AND THE 1976 TANGSHAN EARTHQUAKE

Beijing DIZHEN XUEBAO [ACTA SEISMOLOGICA SINICA; SEISMOLOGICAL JOURNAL]  
in Chinese Vol 2, No 1 Feb 80 p 64

Shi Huixin [4258 1979 7451] and Cai Zuhuang [5591 4371 3552], Hydro-Chemistry Group, The Seismological Brigade of Beijing, and Gao Mingxiu [7559 0682 0208], Institute of Geology, State Seismological Bureau

[Abstract] The character and cause of blowing out of gases and emission of sound from dry wells and of water becoming muddy and changing of level in water wells of the Beijing region immediately before the 1976 Tangshan Earthquake and its strong aftershocks are investigated. These phenomena taken as possible precursors of the earthquakes as well as the motivating force, mechanism, geological background and material sources of the anomalous migration are discussed. Besides, the paper also deals with the relation between these anomalies and the Tangshan earthquake and the significance of the study of groundwater as far as earthquake prediction is concerned.

No gaseous gushing from great depth in considerable quantities appeared so that migration should be regarded only as the migration of shallow

[continuation of DIZHEN XUEBAO No 1 Feb 80 p 64]

groundwater and gases. This is referred to the consequence of the action on certain hydrogeological structures of an impulse-like extra tectonic stress field on the active faults in the Beijing region under a unified regional stress field. The present authors suppose that further studies of the anomalous migration of groundwater and gases possibly may be fruitful to earthquake prediction work.

ON THE ABNORMAL CHARACTERISTICS OF RADON CONTENTS IN THE SPRING WATERS  
NORTH OF THE EPICENTRAL AREA OF THE SONGPAN-PINGWU EARTHQUAKE BEFORE ITS  
OCCURRENCE AND THEIR CAUSE

Beijing DIZHEN XUEBAO [ACTA SEISMOLOGICA SINICA; SEISMOLOGICAL JOURNAL]  
in Chinese Vol 2, No 1 Feb 80 p 73

Wang Changling [3769 7022 1545], Yao Qingchun [1202 1987 2504] and  
Long Ming [7893 2494], Seismological Institute of Lanzhou

[Abstract] In this paper the abnormal characteristics of radon contents in ground waters before the occurrence of the 1976 earthquake ( $M=7.2$ ) in Songpan-Pingwu area have been analyzed. It is pointed out that in the epicentral region--Songpan--and to the north of it, within a distance of about 360 km radon contents in spring waters indicate a tendency of long-term continuous increase superimposed on which are short term variations, lasting about five years. A preliminary explanation of the phenomena is attempted. It is considered that the slow accumulation of tectonic strain in the epicentral area and its surroundings causes the increase of radon contents in spring waters within a broad area and for a long time. Radon in groundwater may be greatly increased when microfractures in the rock-bodies occur. Besides, the supply of spring water may be greatly accelerated by the enhanced vertical differential movement between crustal blocks causing short term variations of the radon contents.

THE CHARACTERISTICS OF ATMOSPHERIC PRESSURE FIELD BEFORE STRONG AND  
MODERATE EARTHQUAKES OCCURRED IN YUNNAN PROVINCE

Beijing DIZHEN XUEBAO [ACTA SEISMOLOGICA SINICA; SEISMOLOGICAL JOURNAL]  
in Chinese Vol 2, No 1 Feb 80 p 79

Zhao Hongsheng [6392 3163 5116], Seismological Bureau of Yunnan Province

[Abstract] In order to seek for short-range precursory phenomena of earthquakes, time space changes of the atmospheric pressure field before strong and moderate earthquakes ( $M_s > 5.0$ ) occurred during 1960-1974 in Yunnan province have been investigated.

Some correlative regions (or stations) of the atmospheric pressure related to three seismic active belts in Yunnan province were selected by the statistical method of optimal two-way classification.

Finally, the results of prediction test within the period 1975-1977 indicate that the anomaly of atmospheric pressure may possibly be an indication of short-range precursor of the occurrence of earthquakes.

THE FORMULAS FOR CALCULATING THE MAGNITUDES OF THE LATE MAXIMUM NEAR AND FAR EARTHQUAKE EVENTS ASSOCIATED WITH GREAT EARTHQUAKES

Beijing DIZHEN XUEBAO [ACTA SEISMOLOGICA SINICA; SEISMOLOGICAL JOURNAL]  
in Chinese Vol 2, No 1 Feb 80 p 89

Zhu Chengxi [2612 2052 3588]

[Abstract] The strain energy of the late maximum near and far earthquake events associated with great earthquakes of magnitude over  $M_s=7.3$  occurred on the mainland of China depends on the following factors, namely,

- (1) The strain energy of the main shock.
- (2) The strain energy of the near maximum shock occurred on the same day as the main shock.
- (3) The strain energy of the near maximum shock occurred within 15 days after the main shock.

The formulas (9) and (10) give the expressions for actual quantitative calculation.

CSO: 4009

PRINCIPLES AND METHODS OF COMPOSING THE SEISMIC ZONING MAP OF CHINA

Beijing DIZHEN XUEBAO [ACTA SEISMOLOGICA SINICA; SEISMOLOGICAL JOURNAL]  
in Chinese Vol 2, No 1 Feb 80 p 110

Deng Qidong [6772 6386 2639], Zhang Yuming [1728 5940 2494], Huan Wenlin [3883 2429 2651], Zhang Hongsheng [1728 7703 3932], Xu Guilin [6079 2710 2494], Liu Yiming [0491 0001 7686], Deng Ruisheng [6772 3843 3934], Li Qun [2626 5028], Fan Futian [5400 4395 3944] and Yang Tianxi [2799 1131 6932]

[Abstract] Under the auspices of the State Bureau of Seismology a seismic zoning map of China (scale 1:3,000,000) has been compiled and issued in 1977 for the purpose of providing data for anti-seismic constructional designing and basic seismic intensity of various regions of the country.

The basic seismic intensity of a region is defined as the maximum intensity to be suffered within a given interval of time in the future under the site condition of that region. The map is a sort of prediction of the basic seismic intensity for the next 100 years after 1973.

[continuation of DIZHEN XUEBAO No 1 Feb 80 p 110

In this paper, the major principles and methods in composing this map are discussed. Of course, as far as the present state of art of seismic zoning is concerned, the principles and methods used involve many shortcomings and therefore the reliability of the map in predicting seismic intensity is still rather uncertain.

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